

Naval Research Laboratory

Washington, DC 20375-5320



NRL/FR/5730--06-10,114

Analysis and Evaluation of the Reconfigured Exponential Troposphere Model (ETM)

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May 10, 2006

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REPORT DOCUMENTATION PAGE

*Form Approved
OMB No. 0704-0188*

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1. REPORT DATE (DD-MM-YYYY) 10-05-2006			2. REPORT TYPE Formal Report		3. DATES COVERED (From - To) Oct. 1, 2003 — Sept. 30, 2004	
4. TITLE AND SUBTITLE Analysis and Evaluation of the Reconfigured Exponential Troposphere Model (ETM)			5a. CONTRACT NUMBER 5b. GRANT NUMBER 5c. PROGRAM ELEMENT NUMBER			
6. AUTHOR(S) Junho Choi and James Connor			5d. PROJECT NUMBER 5e. TASK NUMBER 5f. WORK UNIT NUMBER			
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Naval Research Laboratory Tactical Electronic Warfare Division, Code 5731 4555 Overlook Avenue, SW Washington, DC 20375			8. PERFORMING ORGANIZATION REPORT NUMBER NRL/FR/5730--05-10,114			
9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES) SPAWAR ASD/FMBMB (AFOY) Washington, DC 20050-6335			10. SPONSOR / MONITOR'S ACRONYM(S) 11. SPONSOR / MONITOR'S REPORT NUMBER(S)			
12. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release; distribution is unlimited.						
13. SUPPLEMENTARY NOTES CD on back cover contains FR10,114 in its entirety.						
14. ABSTRACT This report presents a comprehensive analysis and evaluation of the current troposphere database and processing algorithm for eight regional areas (United States, Europe, Middle East, Southeast Asia, Northeast Asia, Amazon Rain Forest, Sahara Desert, and Australia). Software quality evaluation on all troposphere-related programs has been performed by adopting a Cyclomatic Complexity Metrics tool by NIST standard 500-235 issued in September 1995. This report contains a reprogrammed and refined weather database with FNL, ECMWF, MRF, and HIRAS datasets, surface data utility, and automated data processing to increase the processing efficiency and speed. It also establishes new storage and backup procedures for the periods of 1981 to 1990, 1991 to 2000, and January 2001 to the present. This report also describes the redesigned troposphere time-delay and angle error computation program, which defines several new parameters and a data representation methodology for easier access to the database and a more user-friendly interface.						
15. SUBJECT TERMS Refractivity Exponential Troposphere Model Elevation angle Time delay Angle error Refractive index Climatology Range error Troposphere Ionosphere Exosphere GAIM						
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON Junho Choi	
a. REPORT Unclassified	b. ABSTRACT Unclassified	c. THIS PAGE Unclassified	UL	28	19b. TELEPHONE NUMBER (include area code) (202) 767-9050	

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EXECUTIVE SUMMARY

The Exponential Troposphere Model (ETM), developed by the Naval Research Laboratory (NRL), is a real time, atmospheric data assimilated, propagation error-correction algorithm for lower elevation angles. Improvement of the weather database is critical to the efficiency of the ETM model. The consolidation efforts of agencies in the national weather program have led to improved weather datasets, and thus, a comprehensive analysis and evaluation of the current troposphere database and processing algorithm was performed during fiscal year (FY)04–FY05. Changes and improvements in the model execution, data sources, and data storage are discussed, as well as the application of the model for real-time atmospheric transmission correction. Due to the complexity and volume of the global data, only eight regional areas (United States, Europe, Middle East, Southeast Asia, Northeast Asia, Amazon Rainforest, Sahara Desert, and Australia) have been selected for comparison based on their climate extremes, such as the desert, the rainforest, and the monsoon season areas of Eastern Asia. The following areas have been reconfigured and improved:

1. A reprogrammed and refined weather database with four new datasets consisting of NRL's ETM High Resolution, Medium Resolution, Monthly Average, and Monthly-Hourly Average datasets. A data extraction utility was added, and the dataset processing was automated to increase speed and efficiency. New storage and backup procedures were established for the entire range of the database from 1981 to the present.
2. Redesigned tropospheric time-delay and angle-error computation programs by defining several new parameters, improving code readability, and fixing errors. Improved accuracy in all aspects of the program and added more refined and widely accepted data values, such as the World Geodetic System 1984 (WGS84).

These augmentation and reconfiguration efforts have improved the quality and integrity of the troposphere-processing program and weather database. The improved program structure will facilitate the future study of atmospheric radio frequency (RF) propagation, extending the current troposphere model to include free-space and ionospheric effects by adopting data from the Global Assimilated Ionosphere Measurement (GAIM) database.

ANALYSIS AND EVALUATION OF THE RECONFIGURED EXPONENTIAL TROPOSPHERE MODEL (ETM)

1. INTRODUCTION

Radio frequency (RF) propagation through the troposphere is affected by (1) dynamic meteorological conditions in the atmosphere and (2) complex boundary conditions on the ground. Since forecasting of meteorological conditions in small areas of a few square miles is very difficult, the prediction of RF propagation is inherently difficult. Meteorological uncertainties severely limit the usefulness of models of existing microwave propagation, specifically in the presence of precipitation, and many propagation problems on the line-of-sight (LOS) links arise from the occurrence of anomalous departures in the vertical gradient in the refractive index from the normal almost steady value. Atmospheric refraction causes the path of the RF signal to deviate from the geometric straight-line propagation, which is parallel to the air-density gradient for low-elevation angle propagation [1, 2]. Geometrical bending of the RF path is greatly intensified in the troposphere by the curvature of the air density layer. The ray-bending effect of the troposphere is more significant at low elevation angles of less than 5° above the horizon. Ray bending is caused by the effects of (1) humidity, (2) temperature, and (3) pressure conditions, which vary with geographical location and geomagnetic effects.

Considerable interest has been focused recently on signature analyses and classification of synthetic aperture radar data for remote sensing activities; telemetry, tracking, and command (TTC) data; tracking and accurate determination of aircraft or spacecraft position; and orbit parameters (ephemeris) of the satellites, as well as geophysical parameters. An important requirement in most of these applications is the geometric and radiometric calibration of airborne or space-borne data. The nature of dynamic air density properties and atmospheric turbulences produces relatively large measurement errors of spacecraft or aircraft motion by introducing additional geometric and radiometric distortions of the measured sensor data. Errors from tropospheric effects have been generally neglected or ignored during the calibration of collected airborne or space-borne data from remote sensing devices. Further, this atmospheric effect introduces other major sources of errors such as Doppler shifts, and affects the accuracy of ephemeris and geodetic systems.

Geolocation applications using RF propagation in the troposphere at low elevation angles (less than 5° above the horizon) have not been emphasized in the previous three decades. Important details of the properties of received RF signals in the troposphere—e.g., signal amplitude, time delays between different paths, and individual elevation angles under multipath conditions near the ground or over the ocean—are generally ambiguous. Meteorological uncertainties have traditionally limited the usefulness of tropospheric propagation models for error correction of RF propagation, specifically in higher precipitation conditions and at low elevation angles. Many RF propagation problems of the LOS links arise from anomalous departures from the normal condition in the vertical gradient of the refractive index. The standard gradient of refractivity is often quoted as -40 N-unit/km, corresponding to a 4/3 Earth [1]. Thus, at a given site, the refractivity may change by 100 N-units or more during the course of a year, affecting the scale of the errors [1]. At angles of less than 1° above the horizon, extreme refraction effects are sometimes observed as a result of “ducting,” in which temperature inversion causes a reversal in the slope of refractivity vs height. Rays leaving the surface below some critical angle (less than 5° above the horizon) can then be trapped and propagated

for considerable distances around the Earth, leading to large and unpredictable errors in measurement or low-altitude target positions.

The propagation effects of RF in the troposphere produce refractive bending, time delays, Doppler errors, polarization and depolarization (Faraday effects), and dispersion effects. Therefore, two types of errors* are introduced as follows:

1. time-delay errors, which cause range errors in measuring the distance by timing of the RF signal, and
2. angular errors, which cause errors in measuring the elevation angle of RF signal from the target or spacecraft.

The algorithmic corrections of these two error sources have been developed based on model or empirical measurements for different frequencies and climatic regions over the past several decades [1-9]. The time delay occurs primarily because the index of refraction in the troposphere is greater than unity, causing a decrease in the propagation velocity of the RF. The angular error due to ray bending is primarily from the change of the index of refraction with the height of the troposphere. The angular ray bending also increases the time delay. Many troposphere models have been proposed since the early 1950s, including the five leading contenders: Hopfield [3], Goad [7], Blake [6], Takahasi [8], and Moyer [9]. They were comprehensively analyzed by Choi [10], along with other leading candidates. Another good survey paper by Gallini [11] presented several refraction models addressing numerous mapping functions. However, not all of these models are feasible for real-time applications of location measurement from airborne or space-borne sensors because of accuracy issues and slow processing speeds due to their dependence on a full-global, pressure-level dataset.

The ETM, implemented by NRL, satisfies the requirements of real-time processing and RF error compensation by providing an acceptable performance range for both time-delay and angular errors for special applications in both military and commercial operations [11, 12]. This model (ETM) applies over an altitude range of 0 to 27 km including the troposphere (0 to 15 km) and the tropopause (15 to 27 km). The ETM is based on either climatological or real-time meteorological weather data for varying frequencies and climatic regions.

The corrections and improvements from the previous version of the ETM model and database are described in Section 2. The ETM model and delay equations are given in Section 3. The analysis results of the new version, including time-delay and range errors, are presented in Section 4, the recommendations are presented in Section 5, and the conclusion is in Section 6. Section 7 is a guide to the data presented in the appendixes, and Appendixes A-G, included in the enclosed CD, list the data by region. Section 8 presents basic statistical data tables for the data contained in Appendixes A-C.

2. MAJOR IMPROVEMENTS TO ETM MODEL

We reviewed the overall program and database integrity during the period of FY03 to FY05. The findings, modifications, and corrections of the troposphere algorithm and database are presented in this section.

2.1 Database and Raw Data Processing

a. Enhanced geographic resolution

1. Previous dataset of $1^\circ \times 1^\circ$ weather data was not actually $1^\circ \times 1^\circ$ geographical resolution.
2. All other datasets, including $2.5^\circ \times 2.5^\circ$, were incorrectly derived from this dataset.

*The term *error* refers to a deviation from a straight LOS.

3. Data were interpolated and averaged to compensate.
4. New $1^\circ \times 1^\circ$ dataset was acquired from the National Center for Atmospheric Research (NCAR) in Boulder, Colorado, and a new $2.5^\circ \times 2.5^\circ$ dataset was acquired from the National Centers for Environmental Prediction (NCEP) in Camp Springs, Maryland.
5. Created a $2.5^\circ \times 2.5^\circ$ dataset from January 1981 to present and a $1^\circ \times 1^\circ$ dataset from January 2001 to present.

b. Included surface data

1. Previous data did not use true surface data (temperature, pressure, and relative humidity).
2. Surface data were extrapolated using pressure levels.
3. Surface data are currently available and are used in the weather database.

c. Reduced processing time

1. Raw data processing was automated and made more efficient.
2. Processing time was reduced per month by 95 percent (3 hours \rightarrow 10 min).
3. The database now features a user interface rather than shell-script editing.

d. Reduced database storage and backup

1. Previous database was scattered on four different computers; the database is now stored on one server in a logical file structure.
2. The database was previously backed up on a 5-GB tape media; it is now backed up on DVD compact disc media.
3. This results in faster task completion and distribution.

e. Created new 10-year average datasets

f. Documented source code

2.2 Problems with Previous Versions of Troposphere Delay Computation and Implementation of Stratified Layer Model

- a. Too many unnecessary degrees to radian conversions.
- b. Global grid numbers incorrectly calculated and missed.
- c. Apparent angle calculation produced angle errors $>> 1$ percent.
- d. Incorrectly handled negative angles (negatives were flipped positive).
- e. Incorrect grid-crossing algorithm (unrealistic grid crossings).
- f. Used a constant Earth radius instead of WGS84 values.
- g. Did not return all necessary values for a correct delay interpretation.
- h. Cannot determine reference system due to ambiguous station height value.
- i. Cluttered, unnecessary code.

2.3 Ground-up Redesign of Troposphere Delay Computation Program

- a. Variable Earth radius is currently based on latitude and uses WGS84 radius values.
- b. Global grid numbers are calculated correctly and fractional position coordinates are rounded to the nearest grid.
- c. New grid-crossing algorithm takes into account differences in latitude-longitude length, azimuthal direction, and crossing poles.

- d. Implemented a reduced sensitivity to grid-crossing algorithm, which produces smoother transitions.
- e. Equations from the National Geospatial-Intelligence Agency (NGA) are currently used for grid crossings.
- f. Station heights are currently heights above the reference ellipsoid (mean sea level is a good approximation).
- g. Inputs and outputs are more clearly defined in the new computation algorithm.
- h. The stratified layer model algorithm was redesigned and is easier to follow.
- i. Correctly handles negative apparent angles, and allows the method to enter the negative region if necessary.
- j. Program runs at an average of less than 1/2 ms on a Win XP 2.8-GHz system.
- k. Documented source code.

2.4 Well-defined Parameters and Returns

- a. LOS to target.
- b. Apparent angle needed to reach LOS to target.
- c. Actual path range error.
- d. Actual path time delay.
- e. Angle error deviance from desired LOS to target angle.

2.5 Data Representation

- a. Improved data representation and delivery.
- b. Fully customizable data presentations.
- c. Fast deliverable delivery time.
- d. Can handle quick emergency requests.
- e. Global or regional plots, charts, or datasets available for many weather conditions, or any troposphere delay parameter.
- f. Open to any other requests based on need.

3. METHOD OF ETM ERROR COMPENSATION AND RAY BENDING

The ETM model is used to calculate tropospheric range, time, and angle deviations from a free-space propagation path due to RF bending in the troposphere. The heart of the ETM model is the stratified layer algorithm [5], which breaks the atmosphere up into stratified layers. Each layer has an associated refractivity, and therefore, RF bending can be computed by the change in refractivity from layer to layer. Since refractivity exponentially decays as altitude increases, an exponential constant can be found using stratified pressure-level refractivity data [1]. This constant is called the reference height. Using only surface refractivity and the exponential constant reference height, the refractivity at any altitude can be computed. This method is much faster than using complete pressure-level data from the surface to the top of the troposphere (27 km). NRL has combined these methods, along with a database of global surface weather, to produce an algorithm to compute a measure of tropospheric RF propagation deviations.

Referring to Fig. 1, with a given geometric straight LOS to a desired target, the stratified layer algorithm can be performed using the given LOS as a starting apparent angle. When the ray path reaches the top of the troposphere, a calculated LOS angle can be computed. This calculated LOS, due to RF bending, can be compared with the desired LOS to the actual target. If the difference is not within a certain threshold, the apparent angle can be adjusted based on this difference, called LOS error, and the stratified layer algorithm

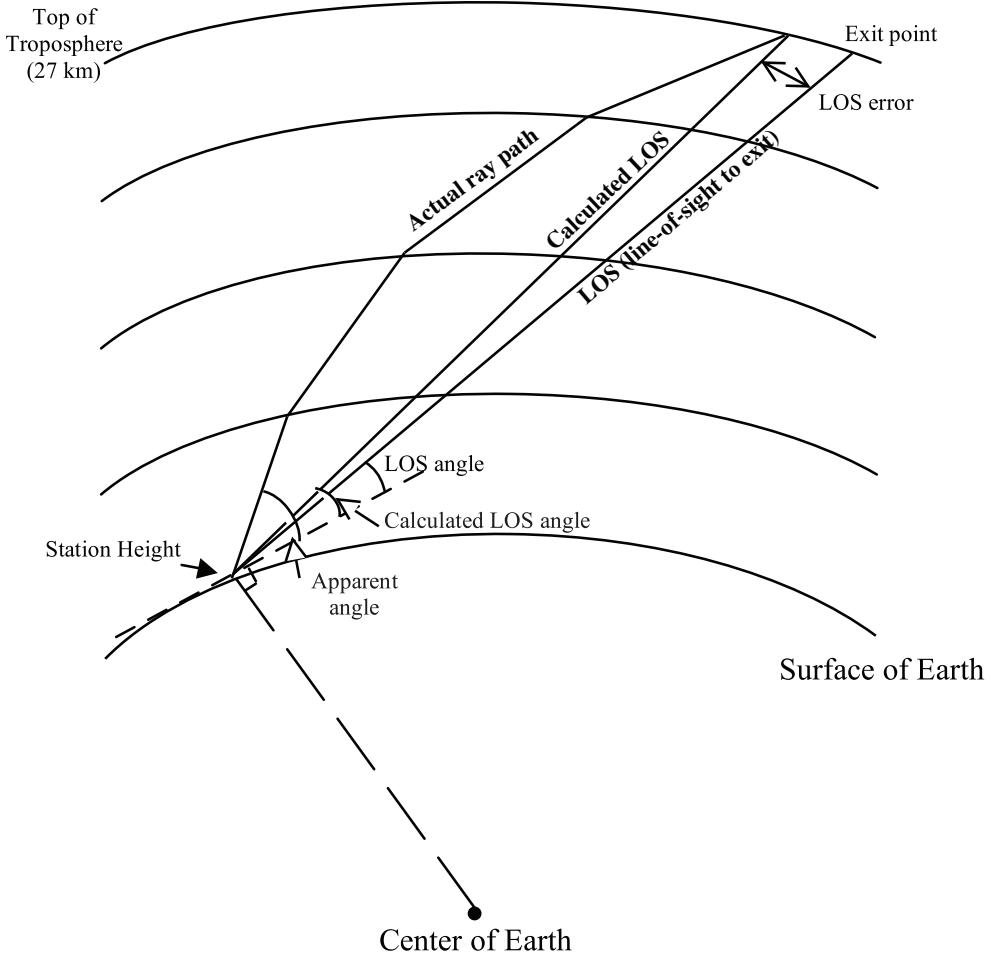


Fig. 1 — ETM algorithm diagram

can be repeated with this new adjusted apparent angle. This process is repeated until the LOS error is within an acceptable threshold.

When the LOS error is within an acceptable range, the range error, or extra distance needed to reach the target due to RF bending, can be calculated. Along with the extra distance is an associated time to travel that extra distance. A time delay can be calculated as the extra time needed to travel that distance. Finally, an angle error can be calculated as the extra degrees one must compensate to reach the desired target.

3.1 Stratified Layer Algorithm [5]

The ETM uses the Stratified Layer Algorithm. This algorithm was implemented in C code and presented here.

3.1.1 Refraction Error

The basic assumption, which the proposed mathematical approach embodies, is that the atmosphere is considered to be stratified into m spherical layers of thickness h_m and constant refractive index n_m . This type of stratification is illustrated in Fig. 2, where α_0 is the apparent elevation angle, and α_{0m} is the calculated elevation angle.

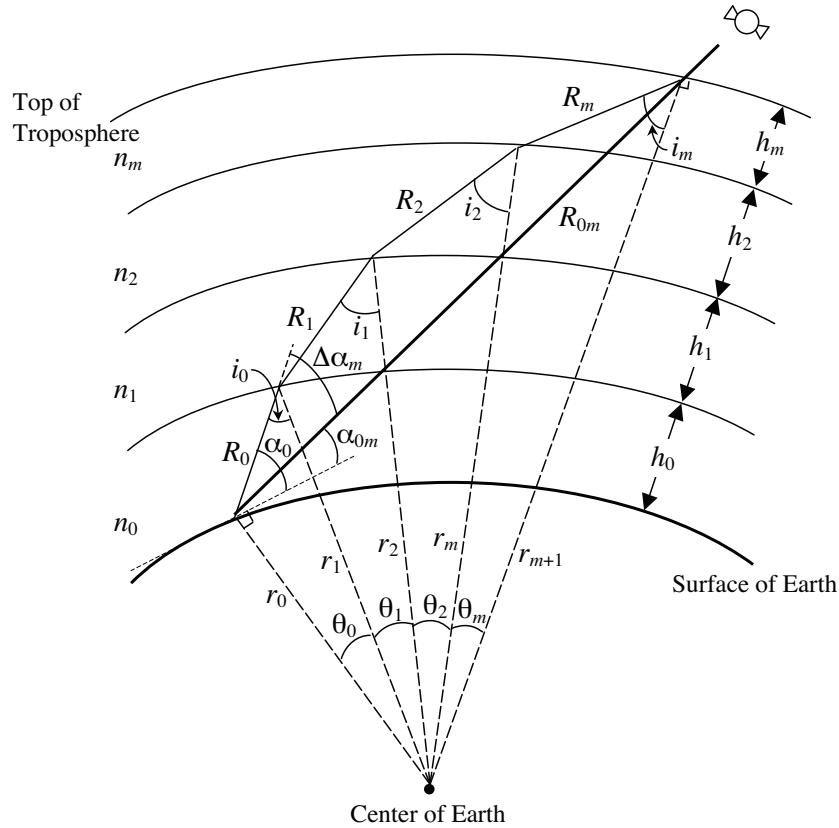


Fig. 2 — Atmospheric layer stratification

From the Law of Sines, the angle of incidence i_0 is found to be

$$\frac{\sin i_0}{r_0} = \frac{\sin(\pi/2 + \alpha_0)}{r_1}, \quad (1)$$

where r_0 is the radius of the Earth and $r_1 = r_0 + h_0$.

The angle that the ray makes with the horizon in layer 1, α_1 , is readily obtainable from Snell's law for a spherically symmetrical surface, which for this example states that

$$n_0 r_0 \cos \alpha_0 = n_1 r_1 \cos \alpha_1. \quad (2)$$

From Eqs. (1) and (2), it is seen that the general expressions for α_m and i_m are given by [5]

$$\alpha_m = \cos^{-1} \left[\frac{n_{m-1} r_{m-1}}{n_m r_m} \cos \alpha_{m-1} \right] \quad (3)$$

and

$$i_m = \sin^{-1} \left[\frac{r_m}{r_{m+1}} \cos \alpha_m \right], \quad (4)$$

where the radial distance r_{m+1} is merely the summation of the various layers expressed by

$$r_{m+1} = r_0 + \sum_{j=0}^m h_j. \quad (5)$$

Applying the Law of Sines again for the direct path, it follows that

$$\alpha_{0m} = \cos^{-1} \left\{ \frac{r_{m+1}}{R_{0m}} \sin \left[\sum_{j=0}^m \theta_j \right] \right\}, \quad (6)$$

where

$$R_{0m}^2 = r_0^2 + r_{m+1}^2 - 2r_0 r_{m+1} \cos \left[\sum_{j=0}^m \theta_j \right] \quad (7)$$

and

$$\theta_j = \pi / 2 - \alpha_j - i_j. \quad (8)$$

The refraction angle error $\Delta\alpha_m$, which is the difference between the apparent elevation angle and the calculated elevation angle, can then be determined from

$$\Delta\alpha_m = \alpha_0 - \alpha_{0m}. \quad (9)$$

It should be noted that, in terms of the above nomenclature, for $m = 0$

$$R_{00} = R_0, \Delta\alpha_m = 0 \quad (10)$$

and, for $\alpha_0 = 90^\circ$,

$$R_{0m} = \sum_{j=0}^m h_j. \quad (11)$$

3.1.2 Time Delay Correction

Referring to Fig. 2, it is seen that the time of travel along the ray path, R_0 , is $t_0 = (R_0/V_{p0})$, where V_{p0} is the phase velocity in the first layer defined by $V_{p0} = (c/n_o)$. It follows, therefore, that the total time of travel of the refracted beam in the stratified layers becomes

$$t_t = (1/c) \sum_{j=0}^m n_j R_j. \quad (12)$$

Since the free space travel time of the unrefracted ray is $t_{0m} = (R_{0m}/c)$, the range error ΔR , which results from the velocity of propagation being less than the free-space velocity and from an increase in path length brought about by the refractive bending of the ray, reduces to

$$\Delta R = \sum_{j=0}^m n_j R_j - R_{0m}, \quad (13)$$

where the distance R_j is given by

$$R_j^2 = r_j^2 + r_{j+1}^2 - 2r_j r_{j+1} \cos \theta_j, \quad (14)$$

and where R_{0m} , r_j , and θ_j are the parameters defined previously above.

3.2 ETM Model Review

The effect of the troposphere on RF propagation produces a variation of the refractive index as a function of height. Horizontal variation of the refractive index is almost negligible relative to the vertical variation. Localized changes of the refractive index with height result in ducting and reflection from elevated layers. The observed refractivity distribution is more closely approximated by an exponential function of height, rather than a linear function as assumed by the effective Earth's radius model. The exponential decrease of the refractivity N with height is sufficiently regular to permit a first-order approximation of N from surface conditions alone [1].

$$N_h = N_s^* \exp(-h / H), \quad (15)$$

where H = a reference (or scale) height appropriate to the value of N at the surface,

N_s = the surface refractivity, and

h = the height above the mean sea surface level in kilometers.

Note: Average values of N_s and H for the United States are approximately 313 and 7.5 km, respectively [1].

The scale height H is the height above the surface, where the refractivity N , at the altitude h , is equal to $1/e$ of the surface refractivity N_s . This uses the assumption that in Eq. (15), the stratified layer height h is equal to the scale height H . The ratio of the dry to wet refractivity is approximately 100 at the reference height H .

The refractive angular bending and time delay beyond this layer of the reference height is limited because the temperature and relative humidity do not change significantly in the stratosphere and beyond. Hence, ray bending and propagation time-delay phenomena occur mainly beneath the reference height. Therefore, the tropospheric effects on ray bending can be approximated as a function of the reference height without sacrificing any significant accuracy.

The ETM not only incorporates the exponential model of Eq. (15), it also allows for the real-time calculation of RF bending given an a priori-established database of reference heights. The ETM provides an accuracy of better than 1 percent of the root mean square (RMS) errors from meteorological data, relative to an accuracy of 20 to 30 percent of RMS errors for the current Hopfield model and other existing models.

NRL adopted the ETM approach because it is one of the most reliable and accurate tropospheric- bending compensation algorithms [10]. In addition, the ETM only requires surface weather data (temperature, pressure, and relative humidity) and reference height along with a global grid number based on latitude and longitude to calculate angle and range errors for the compensation of RF delays and ray-bending effects. This significantly improves the execution speed of the model. The reference height data are derived from hourly, diurnally, and monthly tropospheric pressure-level data. The ETM has evolved from various modifications in order to adapt to real-time weather data. During this evolution period, many government

agencies and DoD contractors have evaluated and examined the ETM model for specific application to sponsors' requirements.

4. ANALYSIS AND EVALUATION OF THE ETM MODEL AND DATABASE

4.1 Database

Weekly, (or daily if necessary), we acquire two datasets. The first is a $1^\circ \times 1^\circ$ dataset from the NCAR. The second is a $2.5^\circ \times 2.5^\circ$ dataset from the NCEP. We convert these two datasets into four separate formats, each one stored in our own weather database. These four formats are the following:

- NRL ETM Monthly Average
 - $2.5^\circ \times 2.5^\circ$ resolution
 - Monthly average (12 files per year)
 - 5-MB-per-year storage
- NRL ETM Monthly-Hourly Average
 - $2.5^\circ \times 2.5^\circ$ resolution
 - Monthly averages at 6-hr intervals: 0000, 0600, 1200, and 1800
 - 4 files per month; 48 per year
 - 20-MB-per-year storage
- NRL ETM Medium Resolution
 - $2.5^\circ \times 2.5^\circ$ resolution of latitude and longitude
 - Daily every 6 hr: 0000, 0600, 1200, and 1800
 - 4 files per day; 1460 files per year
 - 600-MB-per-year storage
- NRL ETM High Resolution
 - $1^\circ \times 1^\circ$ resolution of latitude and longitude
 - Daily every 6 hr: 0000, 0600, 1200, and 1800
 - 4 files per day; 1460 files per year
 - 4-GB-per-year storage

The Monthly, Monthly-Hourly, and Medium Resolution datasets range from January 1, 1981 to the present. The High Resolution dataset ranges from January 1, 2001 to the present. Each separate dataset contains the raw GRIB (Gridded Binary) format and the processed ASCII format. Processing is done to extract weather data into an ASCII readable format and to arrange the data by latitude and longitude for easy access and plotting (Fig. 3).

Our database is stored on a Dell PowerEdge 2650 2.8-GHz dual processor server with a RAID 5-disk storage configuration for data reliability. This is an essential upgrade from the previously used Sun SPARCs running around 133 MHz and using SCSI memory banks. Our new database configuration will allow adaptation to future tasking and upgrades.

4.1.1 Processing Speed for ETM Model

Table 1 shows the execution time in microseconds for the ETM model when it runs at different elevation angles. The time reported in the table is the time the model needs to calculate one time delay, range error,

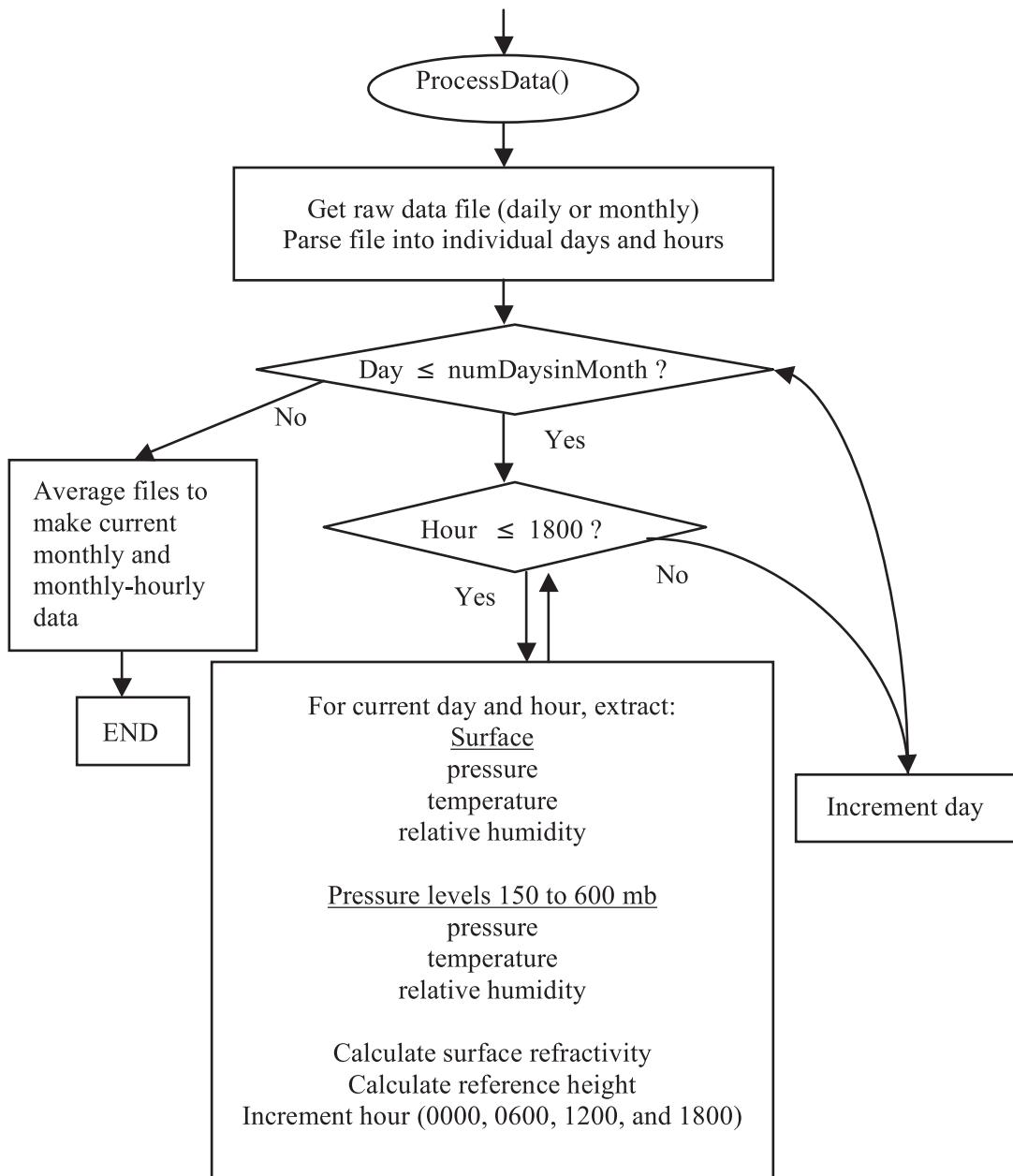


Fig. 3 — Dataset processing flow chart

Table 1 — Average-Processing Times for ETM Execution

Elevation	0°	1°	3°	5°	10°
*Time	582 μ s	542 μ s	424 μ s	361 μ s	360 μ s

*Times recorded on a Pentium 4 running Win XP at 2.8 GHz

and angle error for one latitude-longitude point. Since the model assigns a global grid number to a latitude-longitude point, and the weather database is compiled along with the model, the execution times do not vary with datasets of increasing resolution. For example, to calculate the time delays for every 1° of latitude would require more time than for every 2.5° of latitude due to the greater number of latitude-longitude points, but the model will take the same amount of time to calculate one point with either dataset resolution. The ETM algorithm flow chart is shown in Fig. 4.

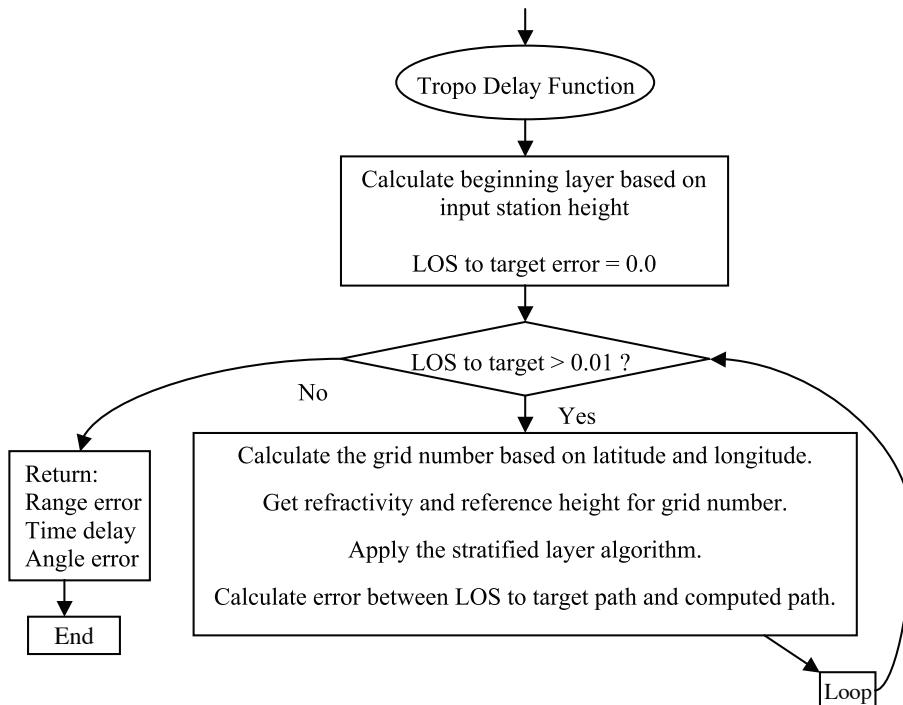


Fig. 4 — Troposphere delay program flow chart

This is a major improvement over the previous model. The previous model used large external ASCII files to hold the weather database, and the weather data had to be read in from an external database for each calculation. The previous model also did not allow for easy integration of both 2.5° and 1° resolution datasets. Overall, the whole model algorithm was redesigned to provide fast results with a minimum amount of steps. The format of the previous model produced execution times in the tens of milliseconds for each elevation angle.

An observation from Table 1 shows that the execution times fall off sharply between 0° and 3°, but then level off around 5° to 10°. This is evident in the nature of the atmosphere at elevation angles close to the horizon. A RF wave with an elevation angle of 1° traveling to the top of the troposphere has to travel a greater distance than a wave of 10° elevation. Not only does the wave have to travel farther but through heavier, moister air. This results in more RF bending. The error-feedback loop of the ETM algorithm has to make more runs to compensate for the bending due to the varying nature of surface weather conditions, whereas a RF wave at 10° will be less affected by surface conditions. This point is illustrated in Fig. 5.

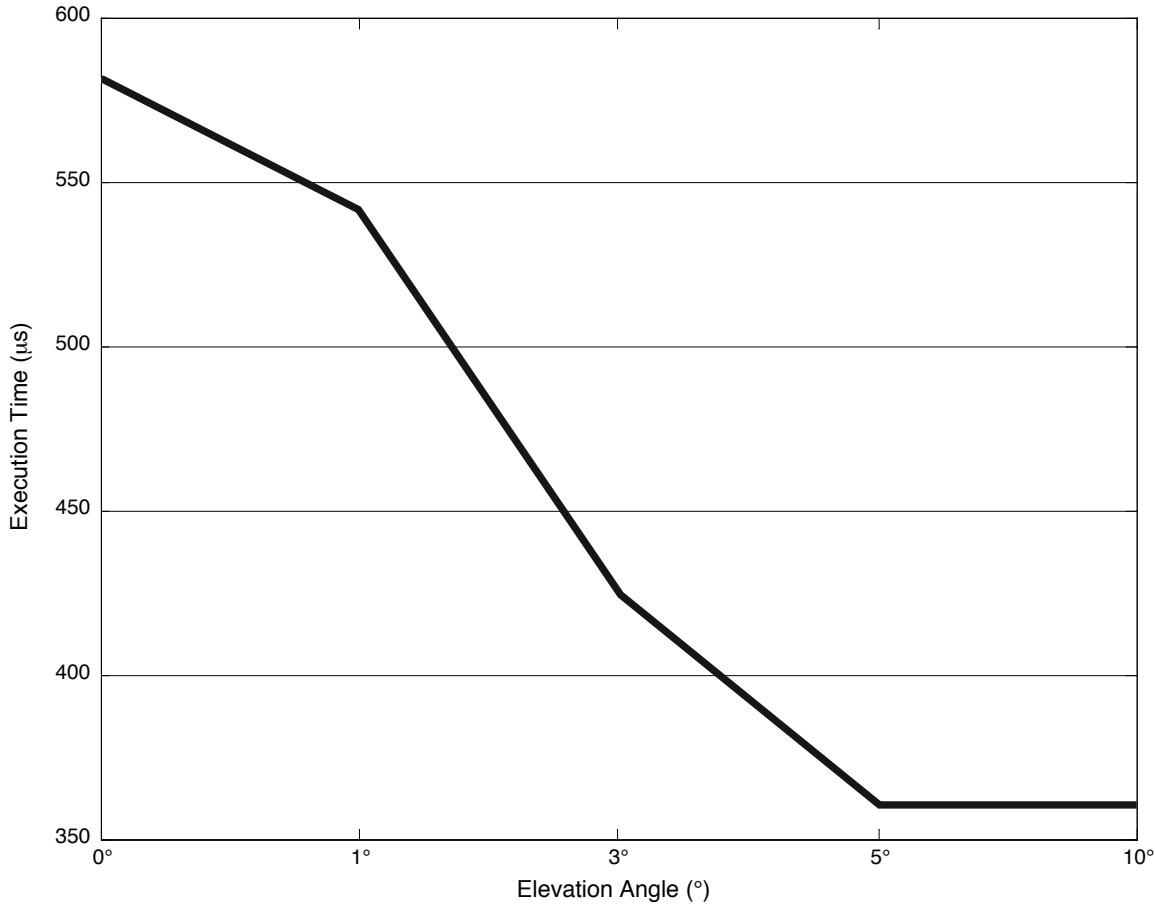


Fig. 5 — ETM model execution speed

4.2 Observations

The 2.5° resolution datasets, ETM Monthly, ETM Monthly-Hourly, and ETM Medium use a sigma level close to the surface to report the surface data. One sigma level is defined as:

$$\sigma = (P - Pt) / (Ps - Pt), \text{ where } Pt = \text{pressure at top level (10 mb)}, \text{ and } Ps = \text{surface pressure}.$$

A sigma level represents a pressure level by reporting a pressure level that is a fraction of the surface pressure. Sigma level 0.995 is reported as the surface data. This corresponds to around 40 m above the surface. The next pressure level of 1000 mb is around 120 m above the surface. The 1° resolution dataset, or ETM High, reports weather data at the actual surface. When comparing ETM High time delay to ETM Medium time delay at the same time of the year and region, the differences are on average less than 1 percent.

The contour plot graphs in the appendixes are generated in MATLAB. The contours are triangulated and represent an area with similar values. The contour levels do not necessarily represent the maximum and minimum values of the region being plotted. Refer to the actual data set behind the plots for the exact value of a certain location. All reported hours in all data files are in UTC/GMT time.

4.2.1 Refractivity Sensitivity

To find out what weather variables have the greatest effect on refractivity, and therefore time-delay and angle errors, a sensitivity test was performed. Each of the three cases is plotted in Table 2.

Table 2 — Refractivity Sensitivity to Weather Conditions

Variable	Refractivity Range (N)	% difference of Max and Min	Standard Deviation
Varying Pressure – Const Temp – Const Humidity	[69.7 - 319.6]	78%	72.25
Varying Humidity – Const Temp – Const Pressure	[263.0 - 376.2]	30%	33.14
Varying Temperature – Const Pressure – Const Humidity	[299.0 - 372.0]	19.6%	19.15

In Table 2, it can be seen that pressure sensitivity has the greatest effect on refractivity, followed by humidity, and then temperature. Comparing these results to a time-delay plot, areas with high pressure generally have greater time delays and angle errors, as shown in Fig. 6. Areas with low pressure generally have low refractivity, and therefore, low time delays and angle errors. Refractivity is very sensitive to pressure due to the rapidly decreasing amounts of water vapor in the atmosphere as pressures decreases. Also from the data, relative humidity has a strong effect on refractivity. Areas with high humidity experience an increase in RF

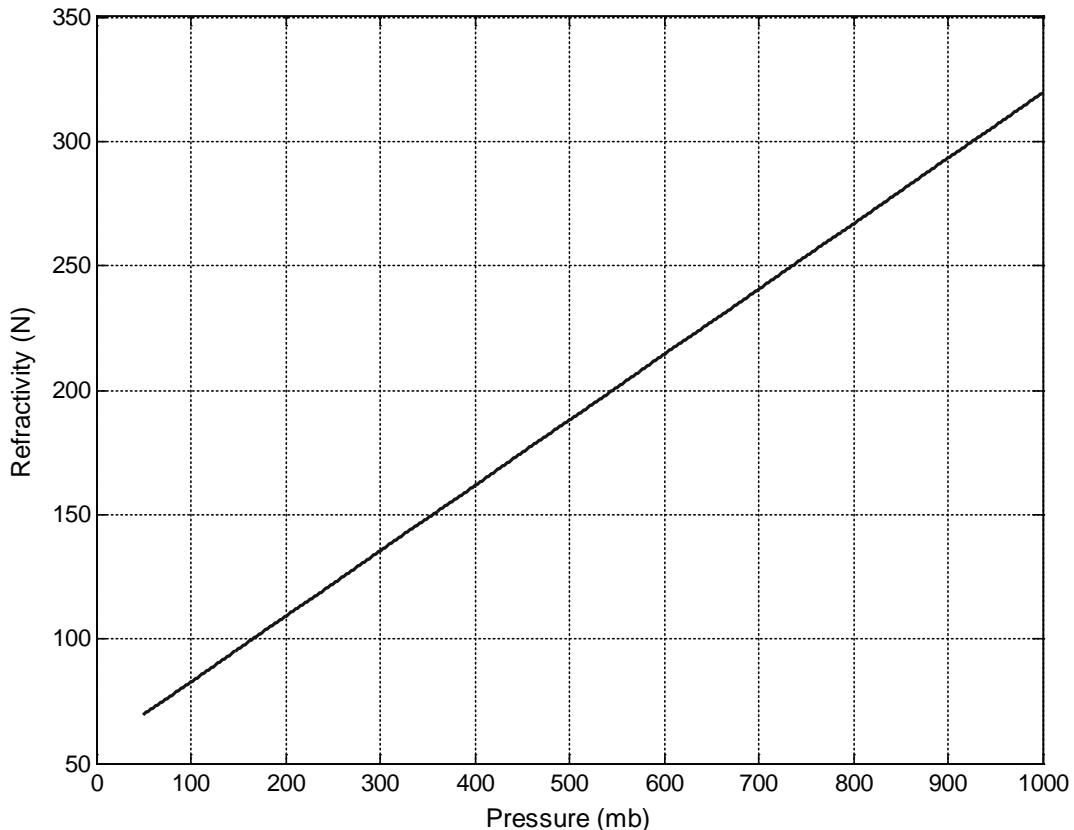


Fig. 6 — Refractivity sensitivity to pressure

refractivity (Fig. 7). This is also shown by looking at the time-delay plots for the Sahara Desert and Amazon regions in Appendixes C and D. The Sahara Desert region averages about 20 percent relative humidity year round, while the Amazon region averages about 93 percent relative humidity year round. At an elevation angle of 0° , the Amazon region experiences a 10-year monthly average of 325 ns of time delay compared to 270 ns for the Sahara Desert region, which is 20 percent less.

Temperature is the least sensitive component of refractivity, but is still important. Temperature, by itself, probably has little effect on RF wave propagation. However, when viewed along with the relative humidity, temperature could have a great effect. With pressure and relative humidity held constant (Fig. 8), and with increasing temperature, for the relative humidity to remain constant, the dew point must rise proportionately. The increased dew point is a direct reflection of the amount of water vapor in the air, which is a harsher environment for RF propagation.

In the varying humidity graph (Fig. 7), an increasing relative humidity at a constant pressure and temperature also implies an increased amount of water vapor in the air. So, one would expect that areas of high temperatures and high relative humidity would carry the most water vapor and, therefore, cause the most RF wave bending. This can be seen in the Amazon and Southeast Asia regions, which are two places on Earth with the greatest time delay and RF bending.

4.3 Analysis Results

4.3.1 Time Delays by Elevation Angle

Figure 9 shows the time delays across the Middle East region at 40° N for different elevation angles. The reduction in RF propagation delay with increasing elevation can be seen clearly. What is interesting to note is that at elevation angles of 0° and 1° , the effects of the surface weather conditions over the region are seen by the varying nature of the curve. This represents the differences in surface climate and altitude through which the RF propagation must travel. Around 3° elevation, the surface effects start to decline due to the wave not spending as much time near the surface layers. The higher the elevation angle, the less the varying surface weather conditions affect the propagation path. Figure 10 illustrates the performance gain by increasing elevation angle.

4.4 Description of Analysis Results for Time Delays and Elevation Angle Errors

The main emphasis on ray bending or propagation delay is centered in the eight regions in this report:

- Amazon Rainforest (Latitude 12.5° N– 17.5° S ; Longitude 82.5° W– 35° W)
- Middle East (Latitude 40° N– 10° N ; Longitude 30° E– 77.5° E)
- Southeast Asia (Latitude 25° N– 12.5° S ; Longitude 90° E– 150° E)
- Northeast Asia (Latitude 55° N– 27.5° N ; Longitude 105° E– 150° E)
- United States (Latitude 50° N– 25° N ; Longitude 125° W– 67.5° W)
- Sahara Desert (Latitude 35° N– 5° N ; Longitude 17.5° W– 30° E)
- Australia (Latitude 10° S– 40° S ; Longitude 112.5° E– 155° E)
- Europe (Latitude 62.5° N– 35° N ; Longitude 12.5° W– 32.5° E)

The United States has been used as a reference for comparison of dynamic behavior of both geographical and elevation angle variations because the quality of the daily meteorological data is better and the United States has more weather stations than any other region on the globe. Many different aspects have been investigated for the verification and validation of the reconfigured and refined data and processing algorithm for

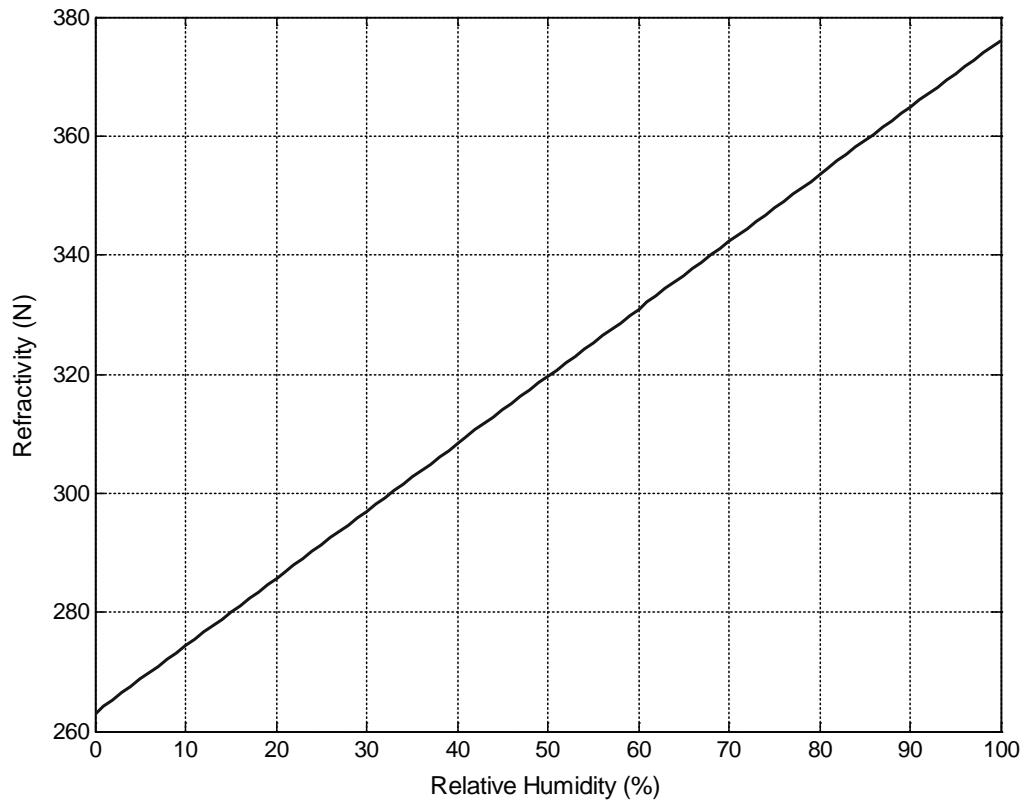


Fig. 7 — Refractivity sensitivity to relative humidity

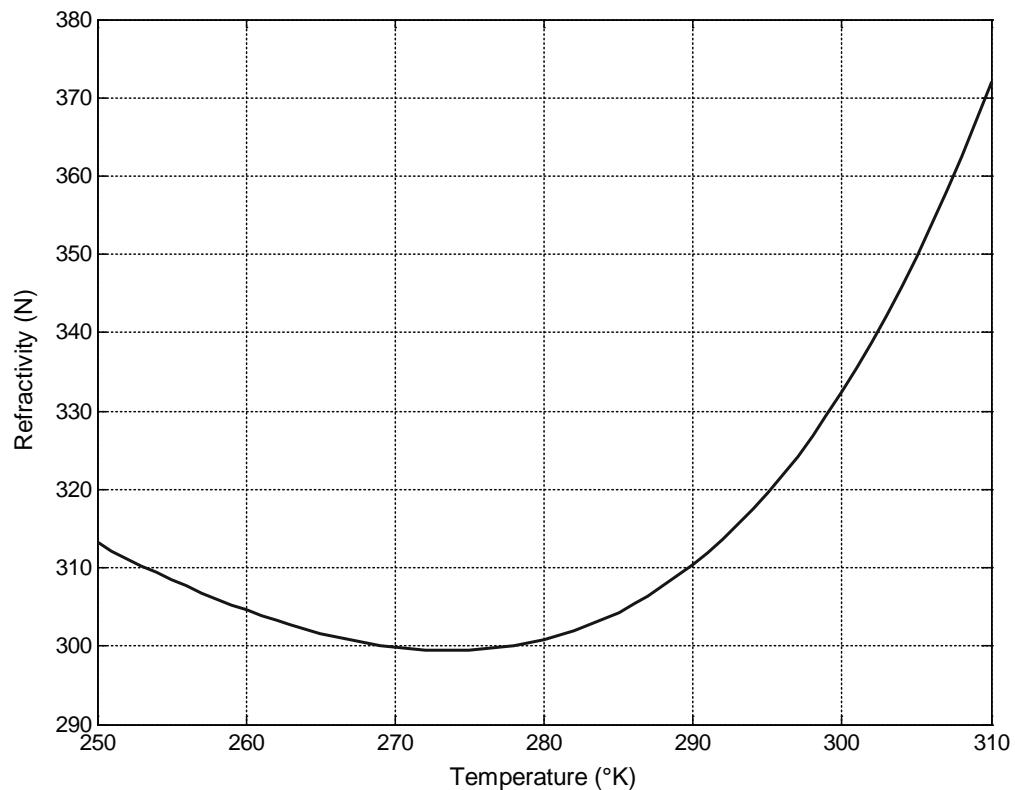


Fig. 8 — Refractivity sensitivity to temperature

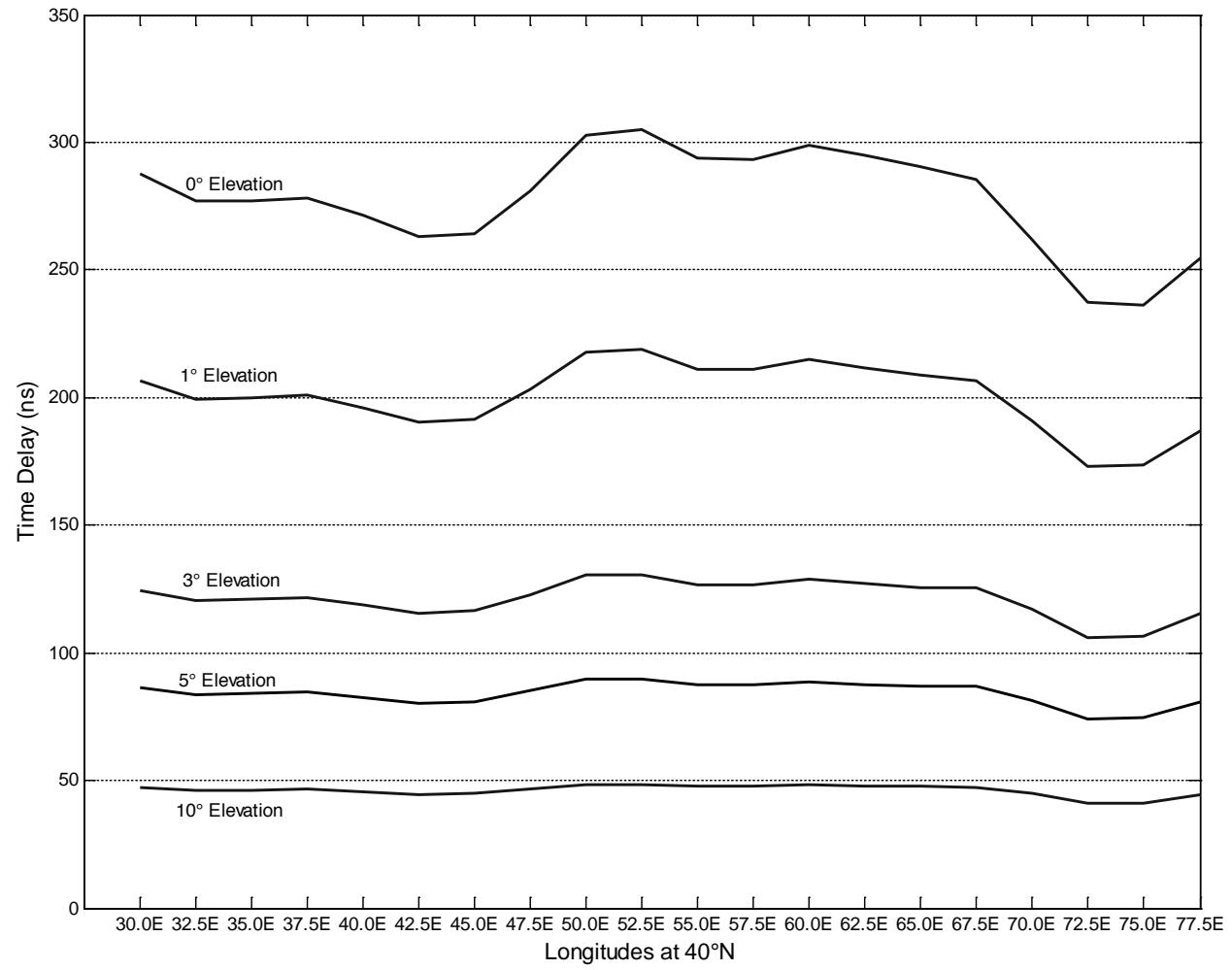


Fig. 9 — Time-delay improvements by varying elevation angle

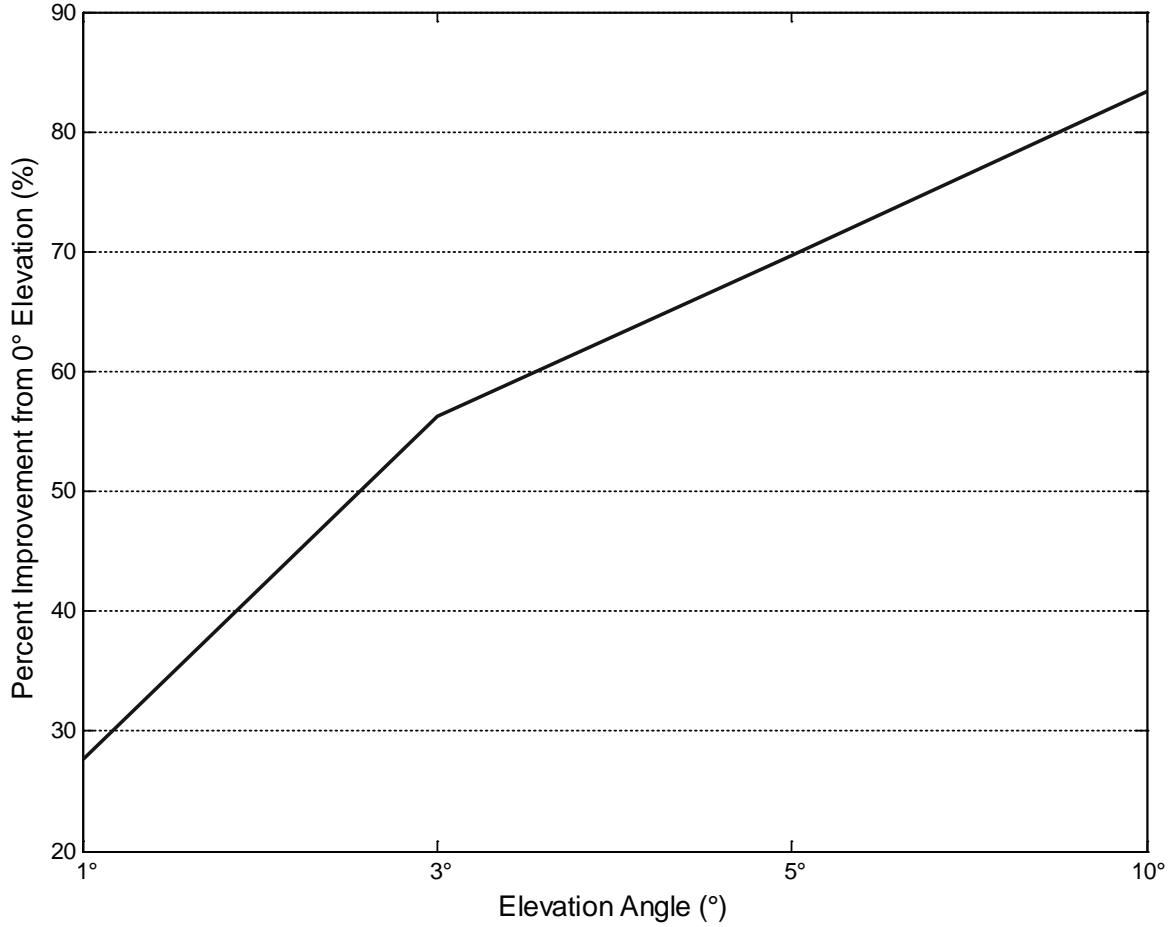


Fig. 10 — Percent improvement by elevation angle

both resolutions ($2.5^\circ \times 2.5^\circ$ and $1^\circ \times 1^\circ$) on the globe. Because of the volume and complexity of the data, not every data table and graph for all regions is included, but they are available upon request.

The elevation angle is one of the most dominating factors in the troposphere region for the propagation anomaly [13]. Details of data analysis and evaluation are presented in the appendixes. Selected topics and regional characteristics are included rather than comprehensive inclusion of all the subjects and characteristics. It is worthwhile to notice that the time delay of the newly reconfigured database and processing algorithm is around an average of 60 ns lower than the previously published one of around 370 to 420 ns. This will enhance the accuracy of the geolocation performance by several hundred feet.

4.4.1 Description of Appendix A

Appendix A covers ETM Monthly 10-year average (1991–2000) range errors for the United States of America and the Middle East. For the United States, data tables present a $2.5^\circ \times 2.5^\circ$ resolution grid performance of range errors from latitudes of 25° N to 50° N to longitudes of 125° W to 67.5° W. When the elevation angle is raised from the horizon to 1° , the range errors are reduced to approximately 29 percent of the horizon range errors for all seasons. When the elevation angle is raised to 3° above the horizon, the range errors are reduced approximately 57 percent, while the range errors are reduced even further to approximately 71 percent for the 5° elevation angle. From the global maps, range errors are more dynamic in April and October than in January and July even though there are higher range errors in July for all angles.

For the Middle East region, data tables show a $2.5^\circ \times 2.5^\circ$ resolution grid performance of range errors from latitudes of 10° N to 40° N to longitudes of 30° E to 77.5° E. When the elevation angle is raised from the horizon to 1° , the range errors are reduced to approximately 28 percent of the horizon range errors for all seasons. When the elevation angle is raised to 3° above the horizon, the range errors are reduced approximately 57 percent, while the range errors are reduced even further to approximately 70 percent for the 5° elevation angle. From the global maps, range errors are more dynamic in July and October than in January and April, even though there are higher range errors in January and April for all angles. It is noticeable that the dynamic behavior of range errors in July can be seen even for 3° and 5° elevation angles in comparison with those of the United States.

4.4.2 Description of Appendix B

Appendix B presents angle errors for the Middle East, the Amazon Rainforest, Northeast Asia, and Southeast Asia using the ETM Monthly dataset 10-year average (1991–2000). For the Middle East, data tables present a $2.5^\circ \times 2.5^\circ$ resolution grid performance of angle errors from latitudes of 10° N to 40° N to longitudes of 30° E to 77.5° E. When the elevation angle is raised from the horizon to 3° , the angle errors are reduced to approximately 53 percent of the horizon angle errors for all seasons while the error is reduced even further to approximately 67 percent for 5° elevation angle. From the global maps, angle errors are more dynamic in the Middle East than other regions. It is recommended that angle-error correction and calibration should be carefully implemented in this region for RF communication, application, and operation.

For the Amazon Rainforest region, data tables show a $2.5^\circ \times 2.5^\circ$ resolution grid performance of angle errors from latitudes of 17.5° S to 12.5° N to longitudes of 35° W to 82.5° W. When the elevation angle is raised from the horizon to 3° , the angle errors are reduced to approximately 54 percent of the horizon angle errors for all seasons. When the elevation angle is raised to 5° above the horizon, the angle errors are reduced to approximately 68 percent. From the global maps, the angle errors are slightly more dynamic in July than in January, April, and October. It is noticeable that the dynamic behavior of angle errors in all seasons is rather stable and consistent even for 3° and 5° elevation angles.

For the Northeast Asia region, data tables show a $2.5^\circ \times 2.5^\circ$ resolution grid performance of angle errors from latitudes of 27.5° S to 55° N to longitudes of 105° E to 150° E. When the elevation angle is raised from the horizon to 3° , the angle errors are reduced to approximately 53 percent of the horizon angle errors for all seasons. When the elevation angle is raised to 5° above the horizon, the angle errors are reduced to approximately 67 percent in January and angle errors are reduced to approximately 68 percent in July. It is interesting to note that the angle errors are increased during the summer season in comparison with other seasons for the region. From the global maps, angle errors are more dynamic in April and October even though the angle errors are higher in July.

For the Southeast Asia region, data tables show a $2.5^\circ \times 2.5^\circ$ resolution grid performance of angle errors from latitudes of 12.5° S to 25° N to longitudes of 90° E to 150° E. When the elevation angle is raised from the horizon to 3° , the angle errors are reduced to approximately 55 percent of the horizon angle errors for all seasons. When the elevation angle is raised to 5° above the horizon, the angle errors are reduced to approximately 69 percent. It is interesting to note that the angle errors are rather consistent throughout the year in comparison with those of the Northeast Asia region. From the global maps, angle errors for Northeast Asia are higher than those angle errors of other regions due to higher concentrations of humidity and higher temperatures throughout the year with little variations.

4.4.3 Description of Appendix C

Appendix C presents time delays for the Middle East, the Amazon Rainforest, Northeast Asia, and Southeast Asia using the ETM Monthly 10-year average (1991–2000).

For the Middle East, data tables present a $2.5^\circ \times 2.5^\circ$ resolution grid performance of time delays from latitudes of 10° N to 40° N to longitudes of 30° E to 77.5° E. When the elevation angle is raised from the horizon to 3° , the time delays are reduced to approximately 59 percent of the horizon time delay for all seasons. When the elevation angle is raised to 5° above the horizon, the time delays are reduced to approximately 72 percent. From the global maps, time delays are very dynamic even for the higher elevation angle for all seasons except for July or the summer season. It is recommended that time-delay correction and calibration should be carefully implemented in this region for RF communication, application, and operation.

For the Amazon Rainforest region, data tables show a $2.5^\circ \times 2.5^\circ$ resolution grid performance of time delays from latitudes of 17.5° S to 12.5° N to longitudes of 35° W to 82.5° W. When the elevation angle is raised from the horizon to 3° , the time delays are reduced to approximately 57 percent of the horizon time delay for all seasons. From the global maps, time delays are rather stable and higher than other regions throughout the year.

For the Northeast Asia region, data tables show a $2.5^\circ \times 2.5^\circ$ resolution grid performance of time delays from latitudes of 27.5° S to 55° N to longitudes of 105° E to 150° E. When the elevation angle is raised from the horizon to 3° , the time delays are reduced to approximately 57 percent of the horizon time delay for all seasons. When the elevation angle is raised to 5° above the horizon, the time delays are reduced to approximately 71 percent. It is interesting to note that the time delays increase during the fall and winter season in comparison with other seasons for the region. From the global maps, time delays are more dynamic in April and October even though the time delays are higher in July.

For the Southeast Asia region, data tables show a $2.5^\circ \times 2.5^\circ$ resolution grid performance of time delays from latitudes of 12.5° S to 25° N to longitudes of 90° E to 150° E. When the elevation angle is raised from the horizon to 3° , the time delays are reduced to approximately 59 percent of the horizon time delay for all seasons. When the elevation angle is raised to 5° above the horizon, the time delays are reduced to approximately 72 percent. It is interesting to note that the time delays are rather consistent throughout the year in comparison with those of the Northeast Asia region. From the global maps, time delays are higher than other regions due to higher concentration of humidity and high temperature throughout the year, with little variations except for more variations in July and October at 3° and higher elevation angles.

4.4.4 Description of Appendix D

Appendix D presents time delays for Australia, Europe, and the Sahara Desert using the ETM Monthly 10-year average (1991–2000) dataset. This appendix covers time delays for elevation angles 0° and 3° for the months of January, April, July, and October.

For Australia, the time delays at 0° elevation are very similar for all seasons while the time delays for 3° elevation vary with each season.

For Europe, the time delays at 0° elevation vary during the July summer season as compared with the other seasons.

For the Sahara Desert, the time delays at 0° elevation vary dynamically throughout the seasons, while the time delays at 3° elevation vary slowly between seasons.

4.4.5 Description of Appendix E

Appendix E presents the comparison graphs of elevation angles (0° and 3° only) and time delays (0° and 3° and 0° and 5°) of regions for the Middle East, Amazon Rainforest, and the United States using the

ETM Monthly 10-year average (1991–2000) dataset. Numerical tables are not included due to the volume. However, all the information and analysis results are available upon request.

For the Middle East, graphs present a $2.5^\circ \times 2.5^\circ$ resolution grid performance of time delays and angle errors from latitudes of 10° N to 40° N to longitudes of 30° E to 77.5° E. The main purpose of direct comparison of low elevation angle is to show the scale of accuracy improvement by elevating the elevation angles of both the receiving and transmitting end. When the elevation angle is raised from the horizon to 3° , the time delays are reduced to approximately 57 percent of the horizon time delay for all seasons. When the elevation angle is raised to 5° above the horizon, the time delays are reduced to approximately 71 percent. From the global maps, time delays are very dynamic even for the higher elevation angles for all seasons except for in July or the summer season. It is recommended that the time-delay correction and calibration should be carefully implemented in this region for RF communication application and operation.

When the elevation angle is raised to 3° above the horizon, the angle errors are reduced to approximately 52 percent of the horizon angle errors.

For the Amazon Rainforest region, graphs show a $2.5^\circ \times 2.5^\circ$ resolution grid performance of time delays from latitudes of 17.5° S to 12.5° N to longitudes of 35° W to 82.5° W. When the elevation angle is raised from the horizon to 3° , the time delays are reduced to approximately 59 percent of the horizon time delay for all seasons. When the elevation angle is raised to 5° from the horizon, time delay is reduced to approximately 61 percent. From the global maps, time delays are rather stable and consistent throughout the year and are higher than other regions year round. Horizon elevation angle errors are in the range of 0.12° to 0.56° , and the angle errors are reduced to approximately 56 percent, when raised to 3° from the horizon.

For the United States, graphs present a $2.5^\circ \times 2.5^\circ$ resolution grid performance of range errors from latitude of 25° N to 50° N to longitude of 125° W to 67.5° W. When the elevation angle is raised from the horizon to 3° , the time delay errors are reduced to approximately 56 percent of the horizon time delay for all seasons. When the elevation angle is raised to 5° above the horizon, the time-delay errors are reduced to approximately 65 percent. From the global maps, time-delay errors are very dynamic. Elevation angle errors are in the range of 0.12° to 0.483° , and the angle errors are reduced to approximately 54 percent by raising the elevation angle to 3° .

4.4.6 Description of Appendix F

Appendix F presents time delays for the Middle East using the ETM Medium Resolution dataset of 2003. Due to the large volume of data, analysis and evaluation results of January 1st and 15th with July 1st and 15th are included in this report for 0000, 0600, 1200, and 1800 UTC/GMT hour each. Tables of data for each grid level of the region are not included due to the data volume. However, it is available to the customer if desired for a particular time of day, day of the month, and year for all data analysis results.

As can be seen in the appendix, only 0° , 3° , and 5° of the elevation angles are presented for each six hours on the 1st and 15th of January and July 2003. For January cases, when the elevation angle is raised to 3° from the horizon, the time delay is reduced to approximately 57 percent of the horizon time delay, while for 5° elevation angles, it reduces to approximately 70 percent. In other words, for 0° elevation, the time-delay range is 208 to 313 ns. It reduces to between 93 and 130 ns when lifted to a 3° elevation angle. It reduces even further for a 5° elevation angle to 65 to 89 ns in this region. For July cases, when the elevation angle is raised to 3° from the LOS, the time delay reduces to approximately 57 percent, while for a 5° elevation angle, it reduces to approximately 70 percent. It is noticeable here that the hourly computation is much finer

and more detailed about the time-delay information. This implies that the hourly data or near-real-time data processing gives better accuracy for the time delay, and consequently accurate geolocation.

4.4.7 Description of Appendix G

Appendix G presents time-delay analysis for the ETM High Resolution dataset of the Middle East specifically during July 1st and 15th of 2003 to avoid large volumes of tables and graphs. It covers the time delay for elevation angles of 0° , 3° , and 5° for the Middle East region. However, all the relevant materials are ready to send if the customer desires to have additional data and analysis results. When we compare these results with those of Appendix F (Medium Resolution), the High Resolution dataset presents much finer time delays and details of each hourly change.

5. FUTURE RESEARCH

Since the ETM model is only valid in the troposphere up to 27 km, an extended model will be developed for the coverage of the entire atmospheric propagation from the ground to the exosphere, including free space and the ionosphere, by adopting the Global Assimilated Ionosphere Measurement (GAIM) database developed by the government-academy consortium. The GAIM data will be available to us in the fall of 2005. In the meantime, the attenuation of RF propagation energy will be developed from the ground to space, including terrestrial communication, by using the Terrain Integrated Rough Earth Model (TIREM) supplied by the Joint Spectrum Center and sponsored by the National Electrical Manufacturers Association (NEMA). For this purpose, the development of a new database of cloud, rain, snow, dust, sand, and fog conditions is required to generate reliable results for the field operation and planning of anomalies in space communications. The geolocation analysis will be performed based on the request of specific mission requirements and operational needs due to the limited funding and support of the project.

6. CONCLUSIONS

New data, processing, and accessing capability of the ETM model has been developed and presented in this report. As presented in Section 4.3, time-delay and angle errors have been improved by at least 10 percentage points overall. Evaluation and analysis have been limited to eight regions specified in Section 4.4 for volume considerations. However, all the information is available on a global level for weather data, time delays, and angle deviations anywhere and anytime for the period of 1981 to the present. These will be delivered to the customer upon request throughout the year. Our newly reconfigured database is more efficient and readily available for current as well as future application needs. Current efforts of database accessibility and extension to the ionospheric region will be very beneficial for the entire RF communication community with applications of atmospheric effects on both tactical operation and strategic planning.

7. LISTING OF APPENDICES

NRL ETM datasets are full datasets as described in Section 4.1. Table 3 lists Appendices A through G. In Appendices A through E, seasonal monthly 10-year averages were processed for analysis and presentation. In Appendices F and G, only the described days and hours were analyzed due to time and space considerations.

8. TABLES OF APPENDIX STATISTICS

Tables 4 through 6 present basic statistics for the data tables in Appendices A, B, and C.

Table 3 — Listing of Appendixes

Appendix	Data Resolution	Type	Elevation Angles (deg)	Time	Region(s)
A	Monthly	Range Error	0, 1, 3, 5	Jan, Apr, Jul, Oct	United States Middle East
B	Monthly	Angle Error	0, 3, 5	Jan, Apr, Jul, Oct	Middle East Amazon Rainforest Northeast Asia Southeast Asia
C	Monthly	Time Delay	0, 3, 5	Jan, Apr, Jul, Oct	Middle East Amazon Rainforest Northeast Asia Southeast Asia
D	Monthly	Time Delay	0 and 3	Jan, Apr, Jul, Oct	Australia Europe Sahara Desert
E	Monthly	Angle Error Compare	0 and 3	January	United States
		Time Delay Compare	0 vs 3 and 0 vs 5		Middle East Amazon Rainforest
F	Medium	Time Delay	0, 3, 5	January 1st and 15th July 1st and 15th 2003 00 06 12 18 Hours	Middle East
G	High	Time Delay	0, 3, 5	July 1st and 15th 2003 00 06 12 18 Hours	Middle East

Table 4 — Appendix A Range Errors

Elevation Change	Yearly Avg. μ (m)	Variance σ^2 (m) ²	One Std. Dev. σ (m)	Min (m)	Max (m)	Coeff. of Variation σ / μ (%)
United States						
0°	88.4	26.0	5.1	76.0	97.6	6%
1°	63.2	8.5	2.9	55.5	68.1	5%
3°	37.7	1.6	1.3	34.0	39.6	3%
5°	26.0	0.5	0.7	23.7	27.0	3%
Middle East						
0°	86.5	38.1	6.2	62.3	98.3	7%
1°	61.9	13.8	3.7	45.5	68.8	6%
3°	37.1	3.1	1.7	27.9	40.2	5%
5°	25.6	1.1	1.0	19.5	27.4	4%

Table 5 — Appendix B Angle Errors

Elevation Change	Yearly Avg. μ ($^{\circ}$)	Variance σ^2 ($^{\circ}$) 2	One Std. Dev. σ ($^{\circ}$)	Min ($^{\circ}$)	Max ($^{\circ}$)	Coeff. of Variation σ / μ (%)
Middle East						
0°	0.37	0.01	0.09	0.13	0.58	24%
3°	0.17	0.00	0.04	0.08	0.26	21%
5°	0.12	0.00	0.03	0.05	0.18	21%
Amazon						
0°	0.48	0.00	0.06	0.18	0.57	13%
3°	0.22	0.00	0.02	0.10	0.26	11%
5°	0.15	0.00	0.02	0.07	0.18	11%
NE Asia						
0°	0.39	0.00	0.06	0.25	0.55	17%
3°	0.18	0.00	0.03	0.12	0.25	15%
5°	0.13	0.00	0.02	0.09	0.17	15%
SE Asia						
0°	0.51	0.00	0.04	0.27	0.56	7%
3°	0.23	0.00	0.02	0.13	0.25	7%
5°	0.16	0.00	0.01	0.09	0.17	7%

Table 6 — Appendix C Time Errors

Elevation Change	Yearly Avg. μ (ns)	Variance σ^2 (ns) 2	One Std. Dev. σ (ns)	Min (ns)	Max (ns)	Coeff. of Variation σ / μ (%)
Middle East						
0°	288.4	423.8	20.6	207.9	328.0	7%
3°	123.8	34.0	5.8	93.1	134.1	5%
5°	85.5	12.1	3.5	65.0	91.4	4%
Amazon						
0°	312.6	180.1	13.4	236.9	332.8	4%
3°	129.4	13.5	3.7	104.9	135.2	3%
5°	88.6	4.2	2.1	73.9	91.6	2%
NE Asia						
0°	295.6	216.4	14.7	253.1	328.6	5%
3°	126.0	13.3	3.6	113.4	135.2	3%
5°	86.8	4.4	2.1	79.1	92.0	2%
SE Asia						
0°	317.8	55.4	7.4	261.7	331.3	2%
3°	130.4	4.0	2.0	116.2	135.1	2%
5°	89.1	1.5	1.2	81.0	91.7	1%

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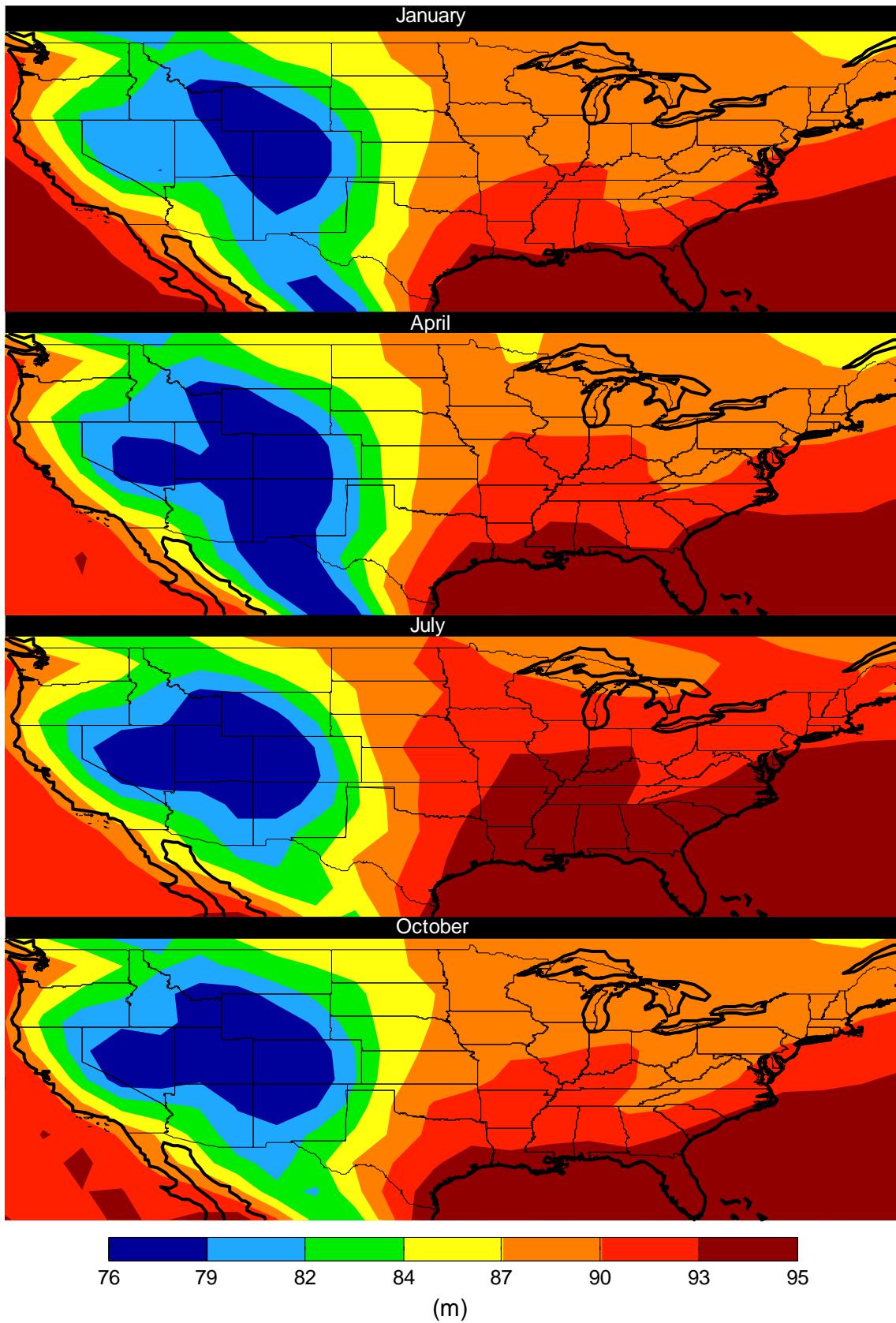
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Appendix A

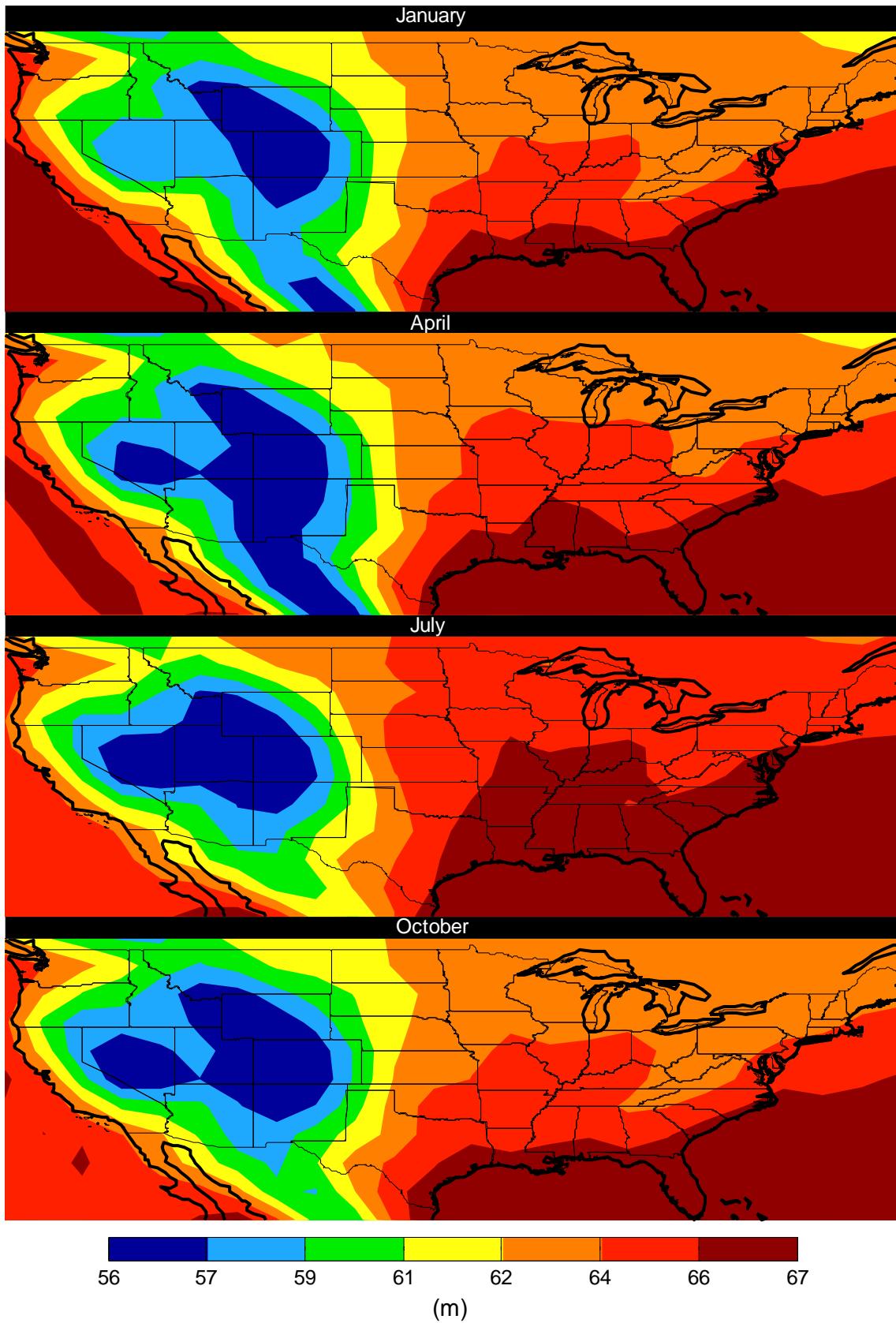
**ECM 1991-2000 RANGE ERRORS
JANUARY, APRIL, JULY, OCTOBER
0, 1, 3, AND 5° ELEVATION ANGLES**

**UNITED STATES
MIDDLE EAST**

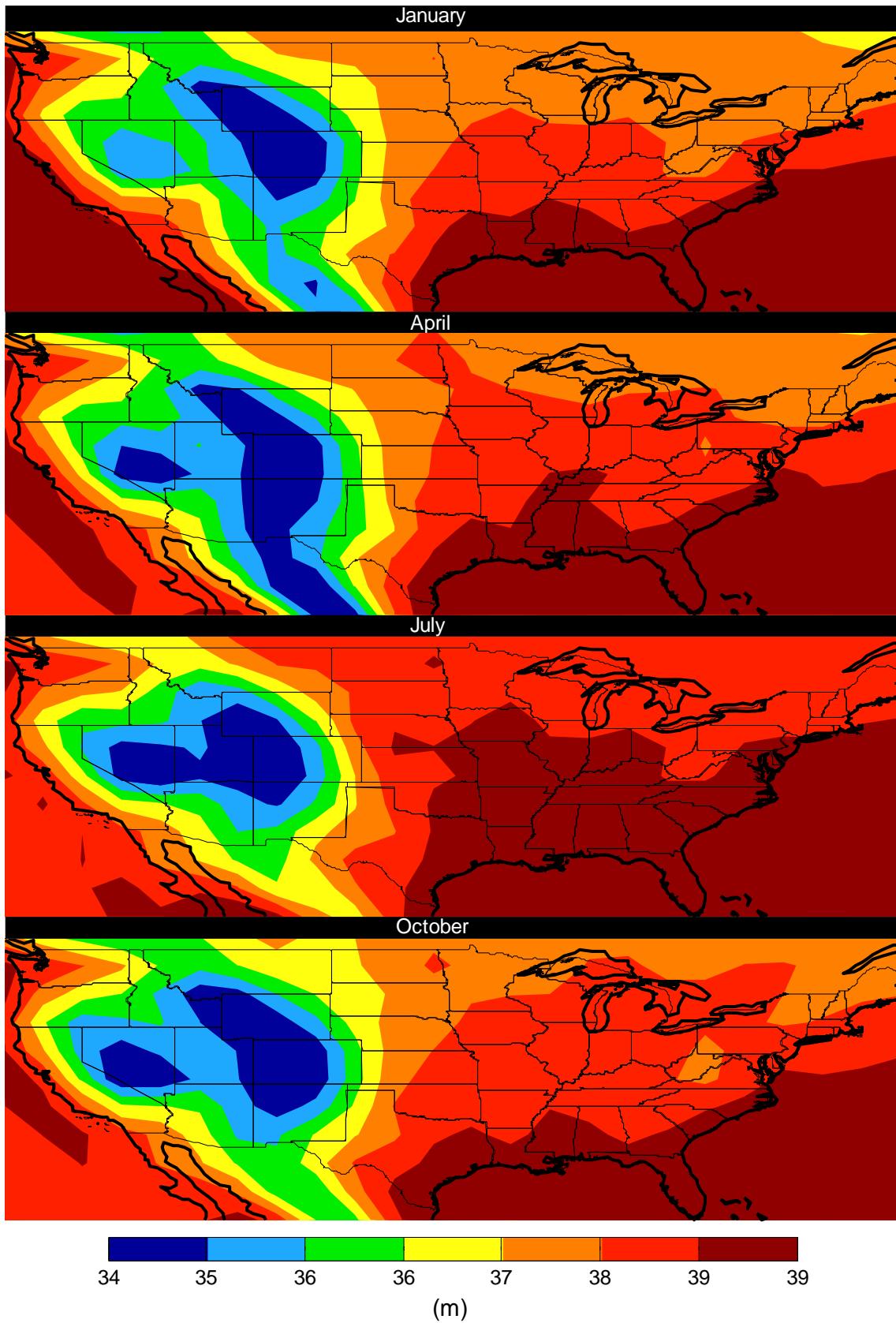
ECM 1991-2000 Range Error 0° Elevation
United States



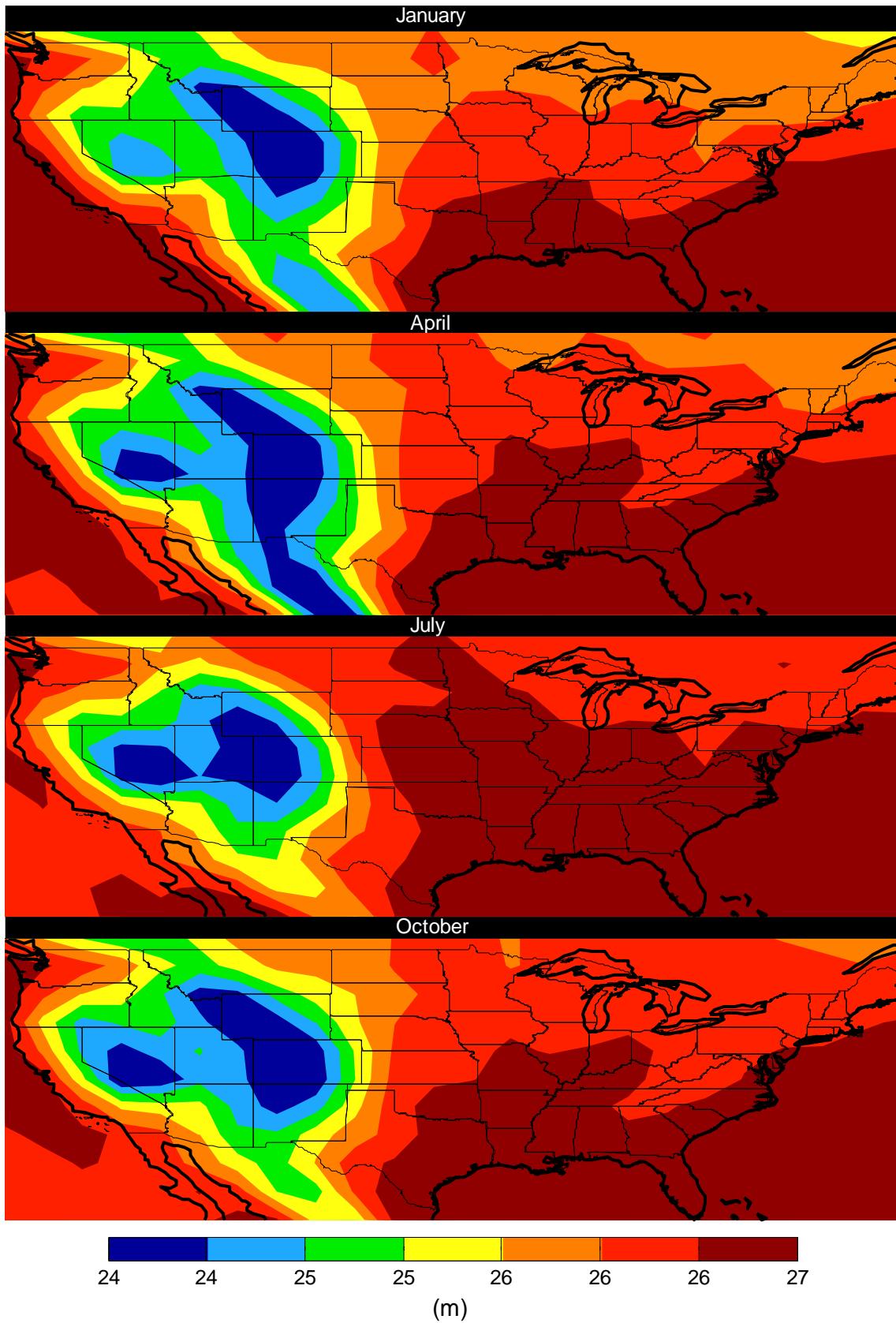
ECM 1991-2000 Range Error 1° Elevation
United States



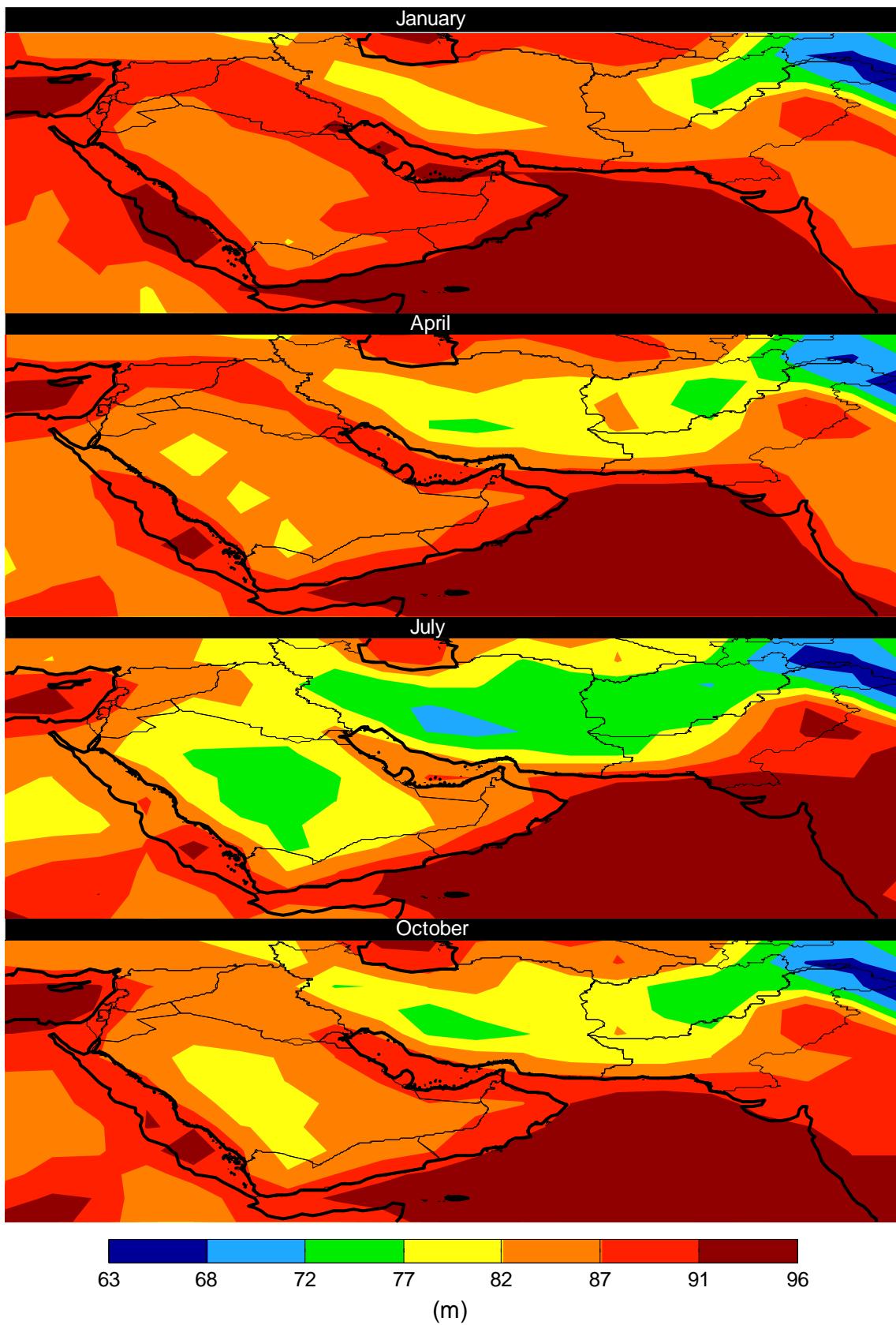
ECM 1991-2000 Range Error 3° Elevation
United States



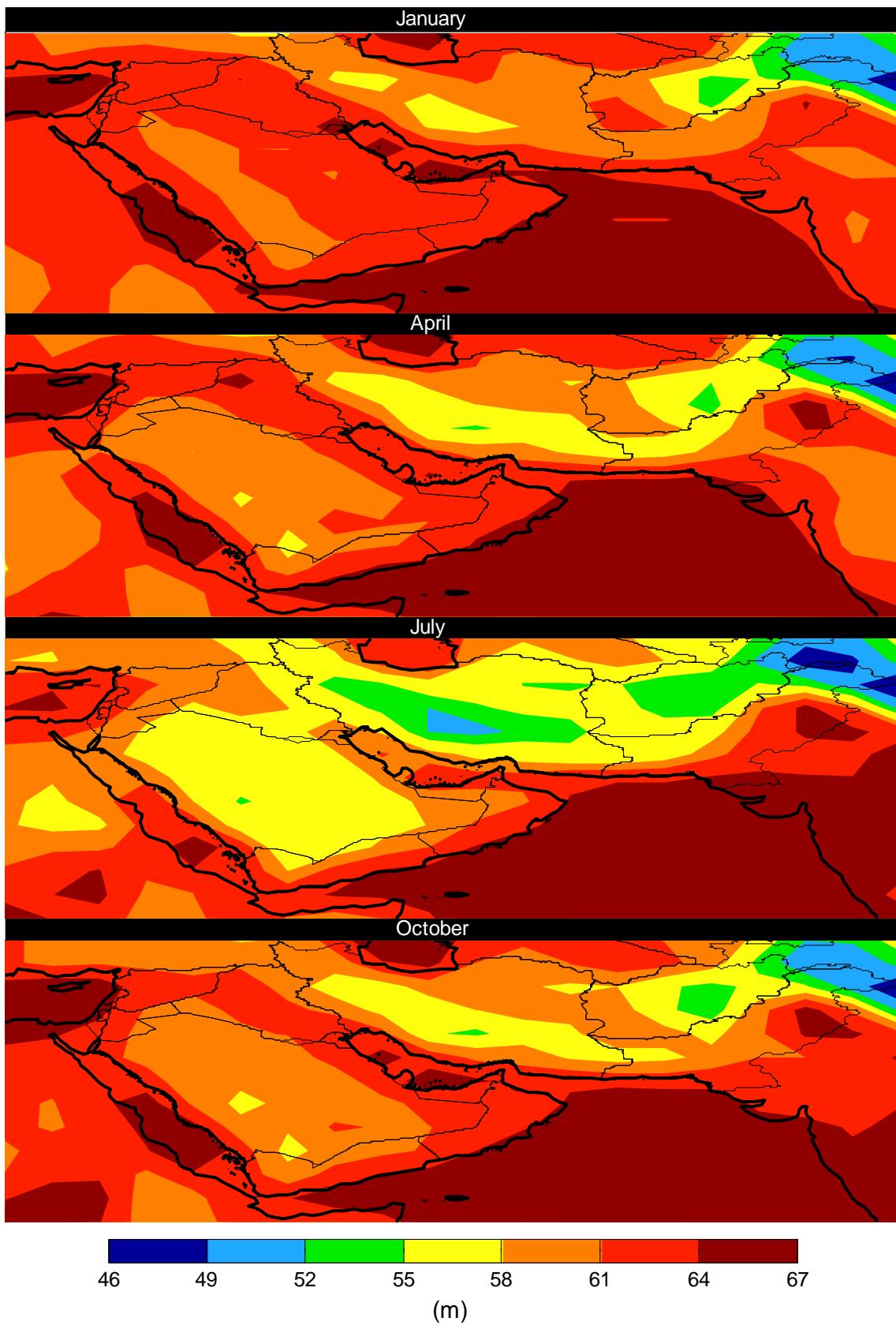
ECM 1991-2000 Range Error 5° Elevation
United States



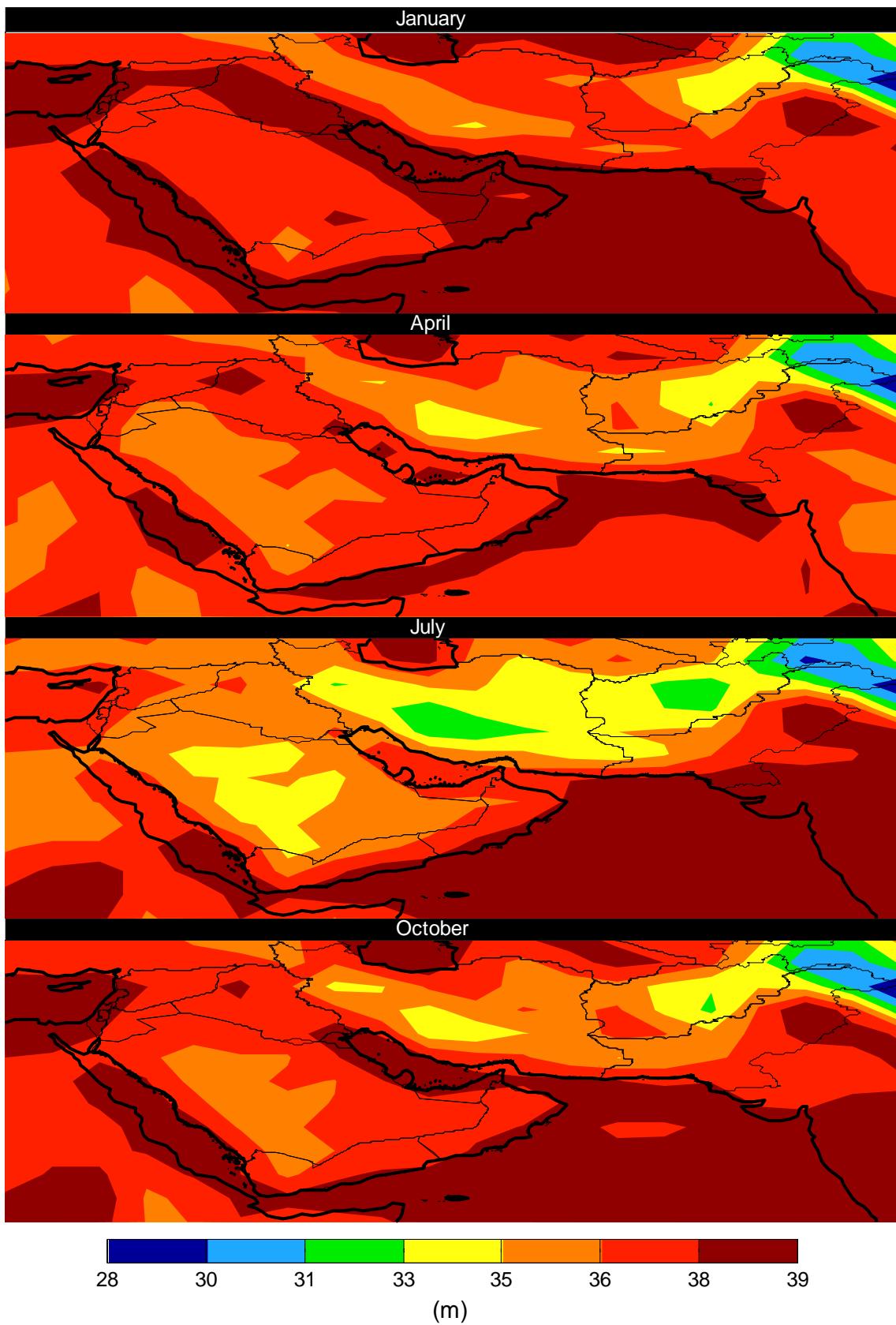
ECM 1991-2000 Range Error 0° Elevation
Middle East



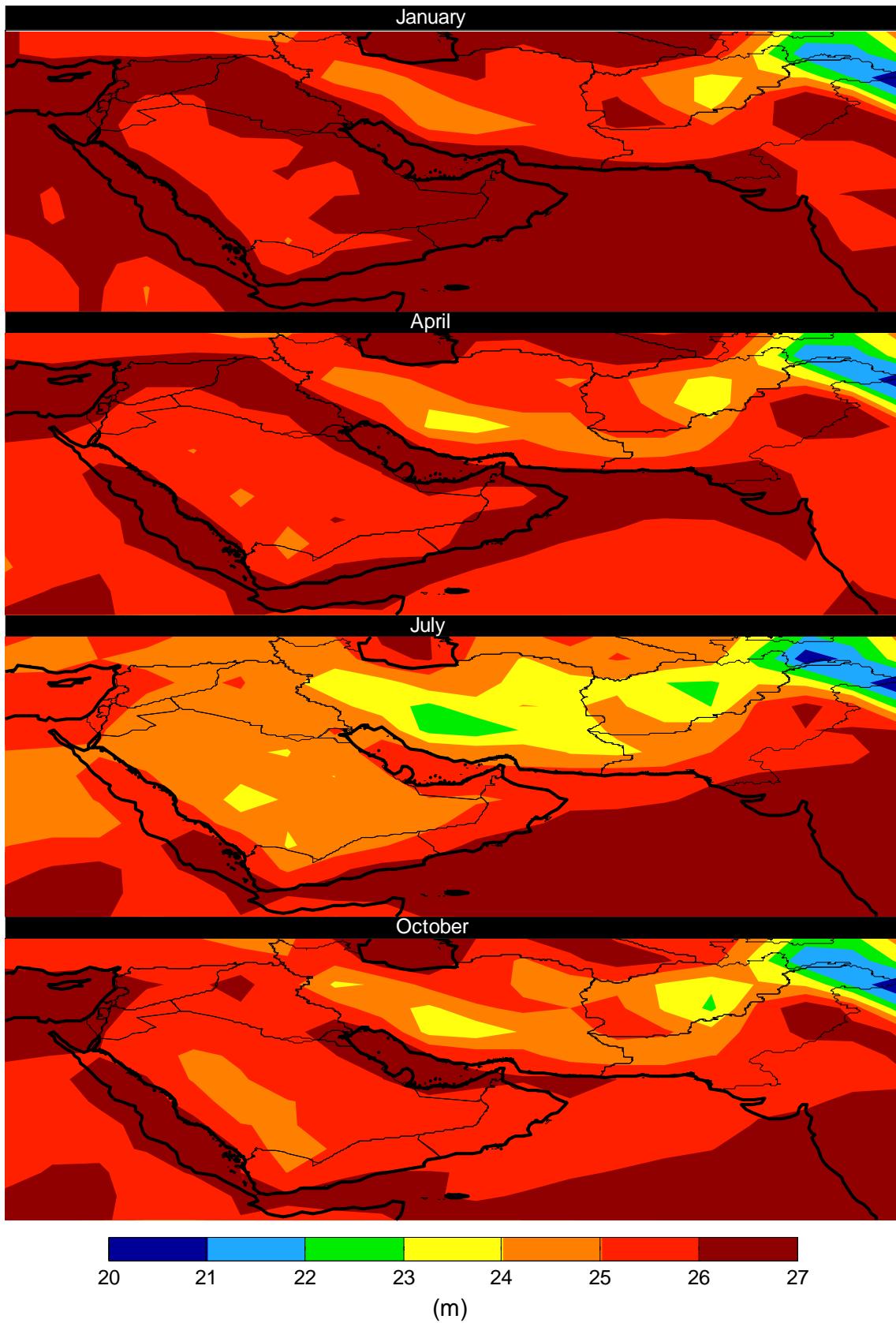
ECM 1991-2000 Range Error 1° Elevation
Middle East



ECM 1991-2000 Range Error 3° Elevation
Middle East



ECM 1991-2000 Range Error 5° Elevation
Middle East



ECM 1991 - 2000 Range Error 0° Elevation (m)

Middle East

January

	30.0 E	32.5 E	35.0 E	37.5 E	40.0 E	42.5 E	45.0 E	47.5 E	50.0 E	52.5 E	55.0 E	57.5 E	60.0 E	62.5 E	65.0 E	67.5 E	70.0 E	72.5 E	75.0 E	77.5 E
40.0 N	86.24	82.99	83.04	83.44	81.32	78.83	79.21	84.29	90.69	91.46	88.13	87.90	89.52	88.45	87.14	85.50	78.54	71.09	70.90	76.33
37.5 N	86.09	84.35	84.73	84.69	84.76	84.24	81.42	80.87	85.53	88.57	85.53	83.18	85.65	88.23	87.09	82.37	74.14	67.04	66.14	71.00
35.0 N	90.24	91.02	90.50	87.41	87.46	89.29	85.29	79.06	78.15	81.98	84.26	82.33	81.34	81.77	78.47	75.07	75.73	74.68	68.32	62.33
32.5 N	91.63	91.60	88.86	84.45	84.48	87.86	88.89	86.61	80.99	77.90	80.75	82.79	83.17	84.26	79.25	75.02	81.63	89.04	82.28	69.21
30.0 N	89.53	88.28	86.02	83.60	84.13	85.52	87.23	91.03	87.92	79.04	77.27	79.67	81.30	84.69	83.58	79.99	83.23	88.26	87.98	83.29
27.5 N	86.81	86.46	86.59	84.22	82.85	83.88	84.10	87.53	91.04	88.20	85.48	85.00	82.62	81.17	81.54	83.02	84.60	83.70	83.85	86.67
25.0 N	86.02	86.28	89.37	88.30	83.48	83.77	84.57	83.93	87.84	91.42	90.60	90.13	90.25	88.83	87.64	87.73	86.78	84.51	83.62	83.78
22.5 N	85.96	84.92	88.51	91.84	86.58	82.35	83.92	84.57	85.52	88.36	87.91	87.73	90.71	92.71	92.61	90.85	87.60	84.91	84.95	85.23
20.0 N	85.74	84.70	86.21	91.94	91.53	83.55	82.68	86.60	86.04	86.57	89.03	90.52	91.51	91.01	90.94	91.60	91.30	87.39	83.68	85.15
17.5 N	84.05	85.13	86.29	90.22	94.76	86.72	80.06	83.81	85.08	86.34	90.24	92.30	92.91	92.19	92.01	91.74	92.64	90.37	84.54	85.19
15.0 N	81.76	84.34	85.55	83.87	89.19	88.21	83.44	87.11	89.91	91.49	92.77	91.99	92.03	91.80	92.85	91.94	92.07	92.68	87.61	87.48
12.5 N	81.29	83.89	84.91	79.92	83.83	90.45	91.20	93.20	92.96	93.08	93.18	92.64	93.48	92.26	92.89	93.16	93.11	94.27	89.59	87.23
10.0 N	83.07	84.66	84.68	79.86	81.31	86.74	87.28	88.30	90.31	92.82	93.34	92.69	93.73	93.35	93.51	93.68	93.19	93.91	92.73	91.45

April

	30.0 E	32.5 E	35.0 E	37.5 E	40.0 E	42.5 E	45.0 E	47.5 E	50.0 E	52.5 E	55.0 E	57.5 E	60.0 E	62.5 E	65.0 E	67.5 E	70.0 E	72.5 E	75.0 E	77.5 E
40.0 N	86.71	84.02	84.68	85.24	82.95	80.52	81.22	86.15	91.71	91.32	87.35	87.20	88.64	87.06	86.34	86.42	80.35	72.66	72.19	77.44
37.5 N	86.67	85.19	86.02	86.44	86.88	86.54	83.65	82.92	86.97	88.79	84.95	82.95	85.56	87.65	87.00	83.81	76.08	68.38	67.33	72.33
35.0 N	91.32	92.00	91.13	87.82	88.10	90.12	86.10	80.08	79.11	82.13	83.59	81.65	80.80	81.27	78.65	76.57	78.03	76.80	69.65	63.12
32.5 N	92.65	92.56	88.84	83.35	82.96	86.21	87.26	85.58	80.83	77.93	80.23	81.42	81.26	82.21	77.99	75.16	83.48	91.53	84.08	70.17
30.0 N	88.91	87.78	84.92	81.77	81.99	83.26	84.90	88.81	85.96	77.55	75.99	78.06	79.37	82.20	81.19	78.93	83.69	89.33	88.55	83.46
27.5 N	84.94	84.53	84.47	82.06	80.85	82.04	82.55	85.80	88.71	85.55	82.87	82.58	80.42	78.86	79.52	82.10	84.60	83.90	83.43	85.42
25.0 N	83.64	83.94	87.21	86.40	81.66	82.15	83.34	82.58	85.92	89.26	88.03	87.54	88.91	88.92	88.85	89.70	88.55	85.45	83.18	82.23
22.5 N	83.32	82.78	86.89	90.34	84.72	80.47	82.45	83.07	83.54	86.02	85.38	86.39	92.28	95.92	96.26	95.20	91.46	86.54	83.95	83.03
20.0 N	83.18	82.72	84.74	90.93	90.72	82.48	81.61	85.52	84.58	84.78	87.72	91.06	94.08	93.34	92.54	94.46	94.64	88.75	82.61	82.96
17.5 N	81.79	83.34	84.80	89.65	95.20	86.87	79.71	83.47	84.84	86.41	91.18	93.90	94.70	93.29	92.62	93.32	94.60	91.21	83.81	83.45
15.0 N	80.84	84.28	85.91	84.19	88.98	87.60	83.30	87.86	91.29	93.10	94.33	92.82	92.45	92.50	93.56	92.92	93.49	94.40	88.05	86.12
12.5 N	83.98	87.47	88.56	82.07	83.51	88.93	90.28	93.25	93.99	94.22	93.76	92.57	93.36	92.52	93.13	93.40	93.77	96.29	91.91	87.61
10.0 N	89.08	90.16	89.19	82.90	83.03	87.59	87.36	87.71	90.01	92.71	92.96	92.23	93.41	93.11	93.42	93.77	92.95	94.52	95.02	93.20

July

	30.0 E	32.5 E	35.0 E	37.5 E	40.0 E	42.5 E	45.0 E	47.5 E	50.0 E	52.5 E	55.0 E	57.5 E	60.0 E	62.5 E	65.0 E	67.5 E	70.0 E	72.5 E	75.0 E	77.5 E
40.0 N	86.51	84.31	85.39	86.02	84.51	82.18	81.38	85.50	92.12	91.58	85.41	83.89	85.43	83.84	82.24	81.77	77.01	71.66	73.09	78.82
37.5 N	84.38	83.96	85.69	84.98	84.06	83.35	80.78	81.93	88.91	90.75	83.61	79.57	82.32	84.20	82.63	79.60	73.73	68.33	69.38	75.35
35.0 N	91.50	93.50	93.42	88.05	85.22	85.21	81.08	76.68	77.79	80.99	80.52	77.81	77.66	78.19	75.71	75.13	77.99	77.56	71.52	65.79
32.5 N	94.64	95.13	91.78	85.18	82.92	83.96	83.15	80.76	76.60	74.45	76.80	78.22	78.45	79.10	76.08	76.28	86.19	93.66	86.66	73.67
30.0 N	90.14	89.33	86.56	82.89	81.93	81.52	81.71	84.96	82.40	74.78	73.42	75.44	76.74	79.44	80.14	81.68	88.75	94.32	94.33	90.26
27.5 N	85.78	85.45	85.08	81.87	79.52	79.42	79.21	82.77	86.76	84.67	82.01	81.25	79.57	79.13	81.40	86.36	90.85	91.11	92.11	95.85
25.0 N	84.29	83.96	85.77	86.02	80.59	79.57	79.89	79.46	84.19	89.39	88.87	88.54	90.97	92.24	92.68	94.11	94.66	93.92	93.56	93.80
22.5 N	83.95	82.09	85.53	89.55	83.35	77.64	79.15	80.05	81.15	84.72	85.12	87.20	94.28	98.32	98.33	97.41	95.99	95.58	95.52	94.99
20.0 N	83.47	81.99	82.67	88.40	88.92	81.24	79.19	82.10	81.83	83.50	87.83	92.33	96.10	95.99	95.52	96.79	98.20	97.61	94.95	94.93
17.5 N	84.23	85.93	86.25	89.02	95.75	89.07	79.18	81.12	84.24	87.69	93.63	96.72	96.58	97.19	97.37	97.71	97.91	95.02	94.17	
15.0 N	87.70	90.95	92.50	87.93	91.73	90.48	88.88	88.24	93.43	95.44	96.79	95.45	95.24	95.72	97.22	97.09	96.52	97.87	95.79	94.00
12.5 N	91.67	92.61	93.61	86.28	86.82	91.06	90.25	92.71	93.80	94.67	95.61	94.96	96.43	96.15	96.13	96.88	96.88	97.96	95.76	92.16
10.0 N	94.59	92.65	90.26	84.47	85.65	89.24	86.89	85.60	87.87	93.22	95.81	94.90	95.83	96.02	96.15	96.48	95.75	96.26	96.94	95.38

October

| | **30.0 E** | **32.5 E** | **35.0 E** | **37.5 E** | **40.0 E** | **42.5 E** | **45.0 E** | **47.5 E** | **50.0 E** |
<th
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |

ECM 1991 - 2000 Range Error 1° Elevation (m)

Middle East

January

	30.0 E	32.5 E	35.0 E	37.5 E	40.0 E	42.5 E	45.0 E	47.5 E	50.0 E	52.5 E	55.0 E	57.5 E	60.0 E	62.5 E	65.0 E	67.5 E	70.0 E	72.5 E	75.0 E	77.5 E
40.0 N	61.98	59.72	59.86	60.20	58.74	57.02	57.37	60.92	65.24	65.57	63.19	63.20	64.39	63.46	62.62	61.97	57.22	51.90	51.99	56.15
37.5 N	61.73	60.61	61.02	61.07	61.20	60.99	59.03	58.57	61.85	63.89	61.60	59.91	61.82	63.78	63.15	60.07	54.20	48.87	48.58	52.45
35.0 N	64.40	65.06	64.95	62.91	63.00	64.35	61.49	57.07	56.52	59.44	61.18	59.61	58.72	59.19	56.85	54.60	55.34	54.55	49.83	45.53
32.5 N	65.26	65.36	63.74	60.76	60.82	63.20	63.87	62.44	58.64	56.51	58.83	60.27	60.34	61.19	57.57	54.34	59.27	64.67	59.79	50.57
30.0 N	64.04	63.22	61.89	60.37	60.84	61.74	62.64	65.34	63.28	56.94	55.92	57.74	58.89	61.54	60.86	58.15	60.22	63.60	63.54	60.63
27.5 N	62.36	62.08	62.28	60.71	59.84	60.66	60.59	62.81	65.30	63.30	61.59	61.35	59.53	58.47	58.81	59.95	61.10	60.31	60.38	62.61
25.0 N	62.01	61.99	64.10	63.40	60.16	60.66	61.22	60.44	62.99	65.34	64.77	64.54	64.60	63.57	62.77	62.94	62.47	61.01	60.40	60.39
22.5 N	62.04	61.06	63.37	65.54	62.11	59.42	60.72	61.03	61.46	63.27	62.76	62.46	64.42	65.67	65.64	64.58	62.62	61.09	61.33	61.57
20.0 N	61.96	61.06	61.76	65.32	65.16	60.13	59.86	62.72	62.00	62.15	63.58	64.24	64.68	64.21	64.19	64.71	64.80	62.58	60.22	61.41
17.5 N	60.80	61.50	62.09	64.31	67.29	62.20	57.72	60.47	60.99	61.59	64.00	65.09	65.41	64.91	64.82	64.61	65.32	64.27	60.56	61.13
15.0 N	59.18	60.98	61.80	60.23	63.84	63.12	59.65	62.35	63.92	64.73	65.35	64.65	64.67	64.49	65.20	64.59	64.67	65.44	62.49	62.52
12.5 N	58.87	60.68	61.50	57.76	60.48	64.76	64.94	66.10	65.58	65.41	65.37	64.98	65.56	64.73	65.14	65.30	65.23	66.19	63.47	61.91
10.0 N	60.01	61.07	61.32	57.90	58.94	62.44	62.36	62.79	63.76	65.12	65.36	64.94	65.65	65.40	65.51	65.61	65.27	65.85	65.32	64.56

April

	30.0 E	32.5 E	35.0 E	37.5 E	40.0 E	42.5 E	45.0 E	47.5 E	50.0 E	52.5 E	55.0 E	57.5 E	60.0 E	62.5 E	65.0 E	67.5 E	70.0 E	72.5 E	75.0 E	77.5 E
40.0 N	62.27	60.40	60.94	61.36	59.77	58.16	58.74	62.17	65.91	65.53	62.79	62.88	63.94	62.61	62.09	62.61	58.53	53.04	52.99	57.01
37.5 N	62.05	61.12	61.85	62.24	62.63	62.53	60.56	59.99	62.88	64.10	61.30	59.94	61.96	63.54	63.18	61.14	55.61	49.87	49.51	53.51
35.0 N	65.00	65.60	65.33	63.24	63.50	64.95	62.13	57.87	57.30	59.67	60.84	59.32	58.58	59.00	57.14	55.78	56.99	56.05	50.80	46.13
32.5 N	65.92	66.00	63.81	60.15	59.94	62.24	62.97	61.96	58.73	56.74	58.67	59.51	59.25	60.04	58.89	54.57	60.51	66.30	61.09	51.35
30.0 N	63.76	63.04	61.33	59.32	59.60	60.43	61.32	64.13	62.25	56.14	55.19	56.87	57.84	60.10	59.43	57.56	60.61	64.32	63.94	60.86
27.5 N	61.32	61.00	61.08	59.46	58.70	59.65	59.79	61.95	64.10	61.86	60.13	59.97	58.23	57.01	57.48	59.34	61.10	60.48	60.16	61.88
25.0 N	60.63	60.67	62.96	62.42	59.17	59.78	60.62	59.77	62.00	64.38	63.48	63.08	63.80	63.51	63.32	63.96	63.47	61.64	60.23	59.52
22.5 N	60.49	59.83	62.54	64.86	61.05	58.28	59.89	60.20	60.32	61.99	61.32	61.67	65.28	67.24	67.30	66.78	64.78	62.09	60.72	60.27
20.0 N	60.42	59.92	60.97	64.89	64.83	59.51	59.24	62.14	61.17	61.11	62.82	64.51	65.96	65.19	64.63	65.83	66.35	63.28	60.07	60.05
17.5 N	59.39	60.40	61.16	64.03	67.71	62.41	57.55	60.29	60.86	61.64	64.54	65.81	66.09	65.19	64.77	65.07	65.96	64.53	60.06	60.05
15.0 N	58.50	60.85	61.93	60.41	63.76	62.84	59.65	62.88	64.75	65.52	66.00	64.85	64.62	64.60	65.23	64.74	65.01	66.02	62.61	61.55
12.5 N	60.44	62.83	63.74	59.13	60.25	63.86	64.45	66.13	66.07	65.81	65.41	64.66	65.19	64.56	64.89	65.01	65.11	66.80	64.65	62.02
10.0 N	63.65	64.34	64.01	59.79	59.96	62.92	62.35	62.34	63.46	64.84	64.89	64.44	65.18	64.93	65.10	65.31	64.78	65.78	66.33	65.39

July

	30.0 E	32.5 E	35.0 E	37.5 E	40.0 E	42.5 E	45.0 E	47.5 E	50.0 E	52.5 E	55.0 E	57.5 E	60.0 E	62.5 E	65.0 E	67.5 E	70.0 E	72.5 E	75.0 E	77.5 E
40.0 N	61.95	60.42	61.17	61.61	60.66	59.27	58.76	61.43	65.73	65.31	61.32	60.60	61.78	60.46	59.34	59.42	56.15	52.39	53.61	57.83
37.5 N	60.13	59.90	61.25	60.89	60.49	60.31	58.54	59.18	63.94	65.17	60.24	57.58	59.76	61.21	60.14	58.16	53.87	49.87	50.94	55.57
35.0 N	64.32	65.66	66.01	62.87	61.30	61.56	58.70	55.50	56.31	58.81	58.62	56.58	56.41	56.84	55.05	54.71	56.79	56.29	51.95	48.01
32.5 N	65.99	66.39	64.86	60.96	59.75	60.67	60.18	58.66	55.81	54.32	56.26	57.30	57.30	57.80	55.47	55.26	62.01	66.89	62.21	53.41
30.0 N	63.75	63.32	61.89	59.77	59.41	59.16	59.15	61.53	59.79	54.17	53.35	55.00	55.91	57.99	58.42	59.02	63.28	66.55	66.66	64.51
27.5 N	61.45	61.22	61.16	59.07	57.63	57.76	57.47	59.86	62.66	61.11	59.31	58.79	57.40	56.90	58.34	61.55	64.35	64.28	64.84	67.46
25.0 N	60.84	60.45	62.40	61.97	58.38	58.01	58.27	57.62	60.74	64.23	63.74	63.36	64.70	65.18	65.28	66.13	66.52	66.15	65.95	66.00
22.5 N	60.80	59.28	61.56	64.31	60.13	56.33	57.67	58.20	58.68	60.98	60.90	61.87	66.20	68.34	68.29	67.88	67.13	67.09	67.22	66.93
20.0 N	60.45	59.26	59.48	63.21	63.65	58.64	57.59	59.85	59.33	60.16	62.72	65.15	67.20	66.92	66.70	67.61	68.58	68.42	66.86	66.98
17.5 N	60.72	61.85	61.92	63.48	68.16	63.95	57.20	58.67	60.50	62.50	66.20	67.79	67.98	67.60	68.09	68.24	68.44	68.71	66.96	66.50
15.0 N	62.80	64.94	66.06	62.78	65.43	64.75	60.09	63.36	66.47	67.34	67.93	66.88	66.79	67.13	68.17	68.15	67.75	68.72	67.56	66.48
12.5 N	65.21	65.83	66.83	61.83	62.36	65.25	64.62	66.22	66.51	66.68	67.09	66.59	67.61	67.45	67.48	68.04	68.02	68.75	67.46	65.12
10.0 N	66.95	65.78	64.66	60.78	61.78	64.12	62.27	61.24	62.44	65.66	67.13	66.50	67.15	67.31	67.44	67.69	67.22	67.58	68.11	67.18

October

	30.0 E	**32.5 E**	**35.0 E**	**37.5 E**	**40.0 E**	**42.5 E**	**45.0 E**	**47.5 E**	**50.0 E**	<b

ECM 1991 - 2000 Range Error 3° Elevation (m)

Middle East

January

	30.0 E	32.5 E	35.0 E	37.5 E	40.0 E	42.5 E	45.0 E	47.5 E	50.0 E	52.5 E	55.0 E	57.5 E	60.0 E	62.5 E	65.0 E	67.5 E	70.0 E	72.5 E	75.0 E	77.5 E
40.0 N	37.33	36.10	36.22	36.44	35.61	34.64	34.88	36.87	39.07	39.12	37.92	38.00	38.65	38.07	37.65	37.58	35.04	31.80	32.00	34.67
37.5 N	37.15	36.56	36.86	36.89	37.00	36.96	35.88	35.61	37.46	38.51	37.16	36.23	37.38	38.48	38.23	36.71	33.28	29.95	29.95	32.64
35.0 N	38.42	38.80	38.87	37.84	37.90	38.68	37.15	34.61	34.36	36.15	37.16	36.15	35.58	35.96	34.65	33.31	33.98	33.53	30.62	27.90
32.5 N	38.76	38.86	38.22	36.66	36.71	38.00	38.34	37.67	35.66	34.45	35.94	36.73	36.61	37.20	35.11	33.07	36.08	39.11	36.53	31.12
30.0 N	38.28	37.90	37.31	36.53	36.85	37.30	37.63	39.01	38.10	34.54	34.03	35.16	35.76	37.39	37.07	35.38	36.52	38.25	38.28	36.98
27.5 N	37.50	37.34	37.50	36.69	36.26	36.76	36.61	37.72	38.97	38.00	37.20	37.14	36.05	35.44	35.66	36.31	36.97	36.46	36.47	37.77
25.0 N	37.38	37.30	38.36	38.05	36.39	36.79	37.09	36.52	37.80	38.85	38.56	38.58	38.09	37.70	37.81	37.63	36.89	36.56	36.51	
22.5 N	37.46	36.82	37.94	38.89	37.38	36.03	36.82	36.89	37.04	37.91	37.58	37.38	38.23	38.70	38.33	37.53	36.86	37.07	37.21	
20.0 N	37.43	36.89	37.15	38.65	38.64	36.39	36.33	37.87	37.37	37.38	37.96	38.11	38.19	37.93	37.92	38.18	38.34	37.54	36.40	37.09
17.5 N	36.82	37.18	37.38	38.22	39.43	37.42	35.06	36.64	36.78	36.99	37.97	38.26	38.33	38.13	38.10	38.01	38.34	38.15	36.54	36.88
15.0 N	35.94	36.91	37.33	36.39	38.13	37.79	36.03	37.43	37.98	38.20	38.32	37.97	37.89	38.16	37.92	37.96	38.43	37.41	37.45	
12.5 N	35.78	36.75	37.24	35.13	36.61	38.50	38.43	38.81	38.45	38.27	38.20	38.05	38.26	37.96	38.11	38.16	38.12	38.55	37.71	37.03
10.0 N	36.38	36.89	37.13	35.29	35.88	37.57	37.37	37.47	37.73	38.15	38.19	38.05	38.32	38.25	38.29	38.32	38.20	38.44	38.38	38.12

April

	30.0 E	32.5 E	35.0 E	37.5 E	40.0 E	42.5 E	45.0 E	47.5 E	50.0 E	52.5 E	55.0 E	57.5 E	60.0 E	62.5 E	65.0 E	67.5 E	70.0 E	72.5 E	75.0 E	77.5 E
40.0 N	37.48	36.48	36.82	37.06	36.17	35.29	35.67	37.53	39.37	39.13	37.78	37.92	38.51	37.69	37.39	37.93	35.82	32.55	32.66	35.21
37.5 N	37.32	36.84	37.31	37.52	37.76	37.79	36.74	36.43	38.04	38.65	37.08	36.36	37.57	38.43	38.27	37.33	34.15	30.59	30.58	33.36
35.0 N	38.64	38.98	39.02	38.03	38.20	39.01	37.54	35.15	34.90	36.36	37.06	36.10	35.65	35.99	34.93	34.10	35.02	34.45	31.27	28.30
32.5 N	39.03	39.15	38.32	36.43	36.35	37.63	38.01	37.54	35.82	34.71	35.99	36.45	36.15	36.71	34.84	33.29	36.82	39.83	37.24	31.65
30.0 N	38.24	37.93	37.15	36.09	36.32	36.76	37.09	38.64	37.72	34.18	33.71	34.80	35.33	36.79	36.44	35.16	36.83	38.62	38.50	37.16
27.5 N	37.10	36.90	37.01	36.14	35.77	36.35	36.32	37.46	38.63	37.43	36.56	36.53	35.45	34.71	34.99	36.04	37.02	36.61	36.44	37.48
25.0 N	36.80	36.73	37.98	37.72	35.98	36.45	36.92	36.29	37.48	38.67	38.19	38.01	38.33	38.11	37.97	38.26	38.10	37.26	36.56	36.15
22.5 N	36.77	36.27	37.67	38.78	36.93	35.47	36.47	36.56	36.54	37.45	37.00	37.09	38.56	38.98	38.90	38.84	38.37	37.41	36.82	36.63
20.0 N	36.73	36.38	36.82	38.61	38.63	36.11	36.06	37.69	37.04	36.96	37.72	38.25	38.50	38.06	37.83	38.20	38.61	37.83	36.10	36.47
17.5 N	36.14	36.67	36.96	38.16	39.69	37.58	34.98	36.60	36.76	37.07	38.21	38.38	38.27	37.98	37.84	37.86	38.18	38.14	36.32	36.38
15.0 N	35.58	36.83	37.36	36.47	38.15	37.74	36.07	37.71	38.30	38.38	38.34	37.85	37.75	37.71	37.86	37.66	37.70	38.30	37.42	37.00
12.5 N	36.57	37.73	38.24	35.86	36.48	38.20	38.31	38.84	38.52	38.18	37.96	37.73	37.87	37.65	37.70	37.68	38.24	38.03	37.06	
10.0 N	38.02	38.32	38.32	36.27	36.38	37.78	37.36	37.27	37.59	37.89	37.82	37.67	37.87	37.76	37.80	37.89	37.75	38.10	38.48	38.34

July

	30.0 E	32.5 E	35.0 E	37.5 E	40.0 E	42.5 E	45.0 E	47.5 E	50.0 E	52.5 E	55.0 E	57.5 E	60.0 E	62.5 E	65.0 E	67.5 E	70.0 E	72.5 E	75.0 E	77.5 E
40.0 N	37.24	36.45	36.85	37.05	36.58	35.90	35.61	36.96	38.95	38.74	36.89	36.65	37.34	36.50	35.88	36.16	34.44	32.17	32.99	35.52
37.5 N	36.20	36.10	36.83	36.46	36.51	35.57	35.87	38.28	38.86	36.39	34.99	36.33	37.12	36.55	35.58	33.09	30.64	31.47	34.43	
35.0 N	37.75	38.30	38.65	37.46	36.83	37.14	35.62	33.80	34.36	35.84	35.75	34.49	34.40	34.72	33.65	33.45	34.79	34.46	31.92	29.53
32.5 N	38.04	38.23	38.09	36.58	36.09	36.66	36.44	35.69	34.15	33.32	34.60	35.16	35.03	35.38	33.95	33.67	37.32	39.53	37.48	32.77
30.0 N	37.62	37.50	37.08	36.17	36.09	35.96	35.84	37.19	36.32	33.04	32.66	33.70	34.18	35.45	35.64	35.77	37.79	38.95	39.07	38.54
27.5 N	36.88	36.77	36.82	35.78	35.07	35.23	34.98	36.25	37.71	36.87	35.97	35.74	34.89	34.57	35.30	36.89	38.16	38.04	38.26	39.42
25.0 N	36.74	36.47	37.46	37.28	35.48	35.43	35.60	35.06	36.69	38.34	38.04	37.83	38.36	38.43	38.42	38.74	38.93	38.89	38.87	38.86
22.5 N	36.84	35.92	37.06	38.40	36.38	34.34	35.24	35.46	35.62	36.83	36.64	36.96	38.70	39.20	39.22	39.27	39.18	39.32	39.46	39.36
20.0 N	36.67	35.95	35.98	37.81	38.06	35.60	35.16	36.51	36.05	36.41	37.58	38.47	39.11	38.98	39.01	39.44	39.85	39.93	39.37	39.46
17.5 N	36.74	37.32	37.28	37.91	40.09	38.36	34.76	35.73	36.61	37.49	39.04	39.48	39.49	39.44	39.75	39.91	40.00	40.16	39.50	39.30
15.0 N	37.70	38.68	39.23	37.62	38.89	38.69	36.34	38.07	39.32	39.51	39.60	39.16	39.17	39.39	39.86	39.94	39.80	40.19	39.80	39.32
12.5 N	38.76	39.07	39.67	37.26	37.54	38.93	38.60	39.30	39.26	39.17	39.23	39.03	39.46	39.49	39.58	39.86	39.87	40.15	39.71	38.66
10.0 N	39.55	39.06	38.77	36.79	37.36	38.45	37.47	36.92	37.42	38.70	39.20	38.96	39.25	39.37	39.48	39.62	39.47	39.62	39.85	39.49

October

	30.0 E	**32.5 E**	**35.0 E**	**37.5 E**	**40.0 E**	**42.5 E**	**45.0 E**	**47.5 E**	**50.0 E**	**52.5 E**	**55.0 E</b**

ECM 1991 - 2000 Range Error 5° Elevation (m)

Middle East

January

	30.0 E	32.5 E	35.0 E	37.5 E	40.0 E	42.5 E	45.0 E	47.5 E	50.0 E	52.5 E	55.0 E	57.5 E	60.0 E	62.5 E	65.0 E	67.5 E	70.0 E	72.5 E	75.0 E	77.5 E
40.0 N	25.88	25.10	25.19	25.34	24.80	24.13	24.27	25.57	26.85	26.84	26.18	26.25	26.63	26.29	26.04	26.05	24.47	22.20	22.36	24.21
37.5 N	25.76	25.39	25.58	25.58	25.65	25.64	24.94	24.76	25.97	25.59	25.76	25.15	25.89	26.55	26.41	25.52	23.25	20.86	20.92	22.92
35.0 N	26.45	26.64	26.69	26.13	26.16	26.62	25.76	24.12	23.96	25.15	25.77	25.12	24.76	25.04	24.18	23.25	23.77	23.51	21.46	19.47
32.5 N	26.60	26.66	26.37	25.45	25.47	26.23	26.43	26.07	24.82	24.00	25.00	25.48	25.39	25.78	24.46	23.03	25.08	26.88	25.45	21.82
30.0 N	26.38	26.19	25.84	25.36	25.55	25.83	26.01	26.74	26.31	24.10	23.76	24.50	24.87	25.88	25.69	24.61	25.35	26.35	26.37	25.68
27.5 N	25.95	25.86	25.95	25.47	25.19	25.51	25.43	26.08	26.69	26.23	25.79	25.76	25.11	24.71	24.84	25.24	25.64	25.32	25.32	26.07
25.0 N	25.86	25.82	26.37	26.23	25.29	25.52	25.71	25.38	26.12	26.58	26.45	26.44	26.48	26.26	26.06	26.10	26.00	25.57	25.38	25.35
22.5 N	25.91	25.55	26.17	26.58	25.89	25.07	25.55	25.59	25.69	26.17	26.01	25.90	26.27	26.42	26.42	26.30	25.95	25.57	25.68	25.76
20.0 N	25.89	25.60	25.76	26.44	26.45	25.33	25.25	26.12	25.85	25.87	26.15	26.18	26.06	26.06	26.16	26.25	25.94	25.30	25.69	
17.5 N	25.54	25.75	25.87	26.25	26.63	25.91	24.51	25.46	25.56	25.69	26.09	26.15	26.14	26.08	26.06	26.04	26.15	26.17	25.43	25.60
15.0 N	25.01	25.59	25.83	25.35	26.20	26.06	25.15	25.88	26.10	26.14	26.14	26.00	26.00	25.97	26.04	25.98	25.99	26.19	25.88	25.88
12.5 N	24.91	25.48	25.77	24.55	25.43	26.32	26.26	26.35	26.19	26.10	26.05	26.01	26.06	25.99	26.02	26.03	26.02	26.17	26.00	25.70
10.0 N	25.28	25.57	25.70	24.63	24.99	25.94	25.85	25.89	25.98	26.10	26.09	26.06	26.13	26.14	26.15	26.16	26.13	26.19	26.24	26.19

April

	30.0 E	32.5 E	35.0 E	37.5 E	40.0 E	42.5 E	45.0 E	47.5 E	50.0 E	52.5 E	55.0 E	57.5 E	60.0 E	62.5 E	65.0 E	67.5 E	70.0 E	72.5 E	75.0 E	77.5 E
40.0 N	25.98	25.35	25.59	25.76	25.18	24.59	24.82	26.00	26.99	26.85	26.13	26.23	26.57	26.09	25.91	26.28	25.01	22.76	22.84	24.60
37.5 N	25.88	25.59	25.87	25.98	26.12	26.15	25.50	25.30	26.33	26.68	25.73	25.27	26.04	26.53	26.44	25.92	23.87	21.33	21.39	23.43
35.0 N	26.55	26.71	26.76	26.26	26.35	26.80	26.01	24.50	24.36	25.32	25.74	25.12	24.84	25.10	24.40	23.82	24.49	24.16	21.95	19.77
32.5 N	26.72	26.79	26.45	25.35	25.29	26.07	26.28	26.02	24.95	24.21	25.07	25.35	25.14	25.52	24.31	23.21	25.59	27.21	25.91	22.22
30.0 N	26.41	26.25	25.79	25.12	25.26	25.53	25.73	26.62	26.13	23.88	23.56	24.30	24.63	25.56	25.34	24.50	25.59	26.57	26.51	25.82
27.5 N	25.74	25.63	25.69	25.15	24.91	25.29	25.27	25.97	26.61	25.95	25.42	24.75	24.27	24.46	25.13	25.72	25.46	25.34	25.94	
25.0 N	25.54	25.50	26.21	26.08	25.05	25.34	25.64	25.25	25.97	26.58	26.33	26.24	26.41	26.31	26.24	26.36	26.28	25.83	25.41	25.15
22.5 N	25.51	25.22	26.05	26.61	25.65	24.74	25.36	25.40	25.41	25.96	25.71	25.78	26.40	26.32	26.23	26.31	26.33	25.92	25.56	25.44
20.0 N	25.49	25.29	25.58	26.48	26.51	25.17	25.10	26.06	25.69	25.66	26.09	26.30	26.20	26.01	25.94	25.96	26.19	26.12	25.15	25.34
17.5 N	25.12	25.45	25.65	26.24	26.77	26.01	24.46	25.45	25.58	25.77	26.23	26.10	25.93	25.90	25.88	25.81	25.86	26.13	25.33	25.32
15.0 N	24.80	25.55	25.85	25.39	26.25	26.07	25.17	26.04	26.23	26.15	25.99	25.85	25.81	25.77	25.74	25.69	25.66	25.92	25.87	25.68
12.5 N	25.41	26.04	26.31	25.01	25.37	26.24	26.27	26.38	26.14	25.91	25.80	25.77	25.76	25.71	25.68	25.65	25.61	25.70	26.05	25.75
10.0 N	26.19	26.34	26.35	25.27	25.32	26.07	25.87	25.84	25.94	25.90	25.81	25.78	25.76	25.73	25.76	25.80	25.89	26.11	26.25	

July

	30.0 E	32.5 E	35.0 E	37.5 E	40.0 E	42.5 E	45.0 E	47.5 E	50.0 E	52.5 E	55.0 E	57.5 E	60.0 E	62.5 E	65.0 E	67.5 E	70.0 E	72.5 E	75.0 E	77.5 E
40.0 N	25.84	25.37	25.61	25.72	25.42	24.97	24.75	25.59	26.59	26.50	25.54	25.39	25.81	25.30	24.91	25.12	24.04	22.48	23.05	24.73
37.5 N	25.22	25.15	25.56	25.40	25.28	25.31	24.71	24.90	26.28	26.58	25.23	24.33	25.19	25.65	25.31	24.74	23.13	21.41	22.03	24.08
35.0 N	25.80	25.96	26.16	25.74	25.43	25.63	24.77	24.02	24.97	24.88	24.04	23.99	24.22	23.51	23.37	24.31	24.14	22.43	20.72	
32.5 N	25.67	25.74	25.96	25.35	25.04	25.36	25.24	24.81	23.84	23.29	24.14	24.47	24.37	24.61	23.69	23.50	25.78	26.78	25.94	23.02
30.0 N	25.80	25.78	25.62	25.13	25.06	24.96	24.88	25.66	25.21	22.87	23.57	23.85	24.64	24.76	24.87	26.02	26.47	26.44	26.54	26.47
27.5 N	25.53	25.48	25.50	24.89	24.44	24.53	24.37	25.14	25.94	25.51	24.99	24.87	24.38	24.19	24.65	25.56	26.21	26.20	26.32	26.76
25.0 N	25.45	25.29	25.80	25.71	24.69	24.65	24.75	24.42	25.41	26.22	26.08	25.97	26.20	26.22	26.24	26.39	26.52	26.61	26.66	26.68
22.5 N	25.51	24.97	25.64	26.30	25.26	23.98	24.55	24.68	24.79	25.54	25.45	25.63	26.37	26.37	26.43	26.61	26.75	26.88	26.97	26.95
20.0 N	25.44	25.02	25.06	26.06	26.19	24.82	24.51	25.34	25.07	25.31	25.99	26.39	26.60	26.62	26.74	26.94	27.09	27.20	27.02	27.04
17.5 N	25.51	25.85	25.84	26.17	27.14	26.42	24.31	24.92	25.49	26.00	26.70	26.82	26.81	27.11	27.26	27.32	27.37	27.13	27.02	
15.0 N	26.10	26.58	26.83	26.08	26.66	26.60	25.36	26.29	26.85	26.92	26.90	26.79	26.84	27.00	27.21	27.32	27.30	27.41	27.28	27.02
12.5 N	26.67	26.83	27.13	25.90	26.02	26.70	26.56	26.84	26.83	26.79	26.78	26.72	26.88	27.00	27.10	27.24	27.27	27.34	27.22	26.71
10.0 N	27.11	26.88	26.77	25.62	25.93	26.47	26.01	25.73	26.03	26.58	26.73	26.68	26.79	26.90	26.98	27.06	27.05	27.11	27.18	27.04

October

	30.0 E	**32.5 E**	**35.0 E**	**37.5 E**	**40.0 E**	**42.5 E**	**45.0 E**	**47.5 E**	**50.0 E**	**52.5 E**	**55.0 E**	**57.5 E**	**60.0 E</b**

ECM 1991 - 2000 Range Error 0° Elevation (m)

United States

January

	125.0 W	122.5 W	120.0 W	117.5 W	115.0 W	112.5 W	110.0 W	107.5 W	105.0 W	102.5 W	100.0 W	97.5 W	95.0 W	92.5 W	90.0 W	87.5 W	85.0 W	82.5 W	80.0 W	77.5 W	75.0 W	72.5 W	70.0 W	67.5 W
50.0 N	85.77	83.51	81.66	80.49	80.67	82.34	84.41	85.31	85.25	85.70	86.84	87.40	87.05	86.67	86.73	86.93	87.13	87.45	87.60	87.23	86.49	85.88	85.70	86.04
47.5 N	89.80	88.08	86.08	83.88	81.65	80.91	82.27	84.01	84.66	85.19	86.43	87.28	87.01	86.53	86.60	86.86	86.84	86.77	86.92	87.07	86.88	86.44	86.27	86.77
45.0 N	89.98	86.70	84.09	82.58	80.32	78.07	78.22	80.39	82.53	84.07	85.43	86.43	86.87	87.02	87.09	87.15	87.21	87.27	87.29	87.10	86.66	86.47	86.82	87.44
42.5 N	89.63	84.68	81.12	80.78	80.61	78.72	77.01	77.32	79.61	82.81	85.22	86.34	87.11	87.58	87.39	87.31	87.63	87.59	87.29	87.04	86.79	87.11	88.12	88.81
40.0 N	90.70	86.79	81.57	79.00	79.44	79.68	77.84	76.04	77.26	81.32	84.98	86.55	87.57	88.29	88.21	88.36	88.47	87.44	86.78	87.60	88.48	88.88	89.48	89.80
37.5 N	92.07	90.57	84.58	79.27	78.85	80.07	78.62	76.38	77.24	81.28	85.20	86.93	87.80	88.67	89.05	89.13	88.57	87.25	87.08	88.78	90.21	90.49	90.84	91.26
35.0 N	91.92	92.14	88.86	85.02	84.18	83.21	79.87	77.88	79.01	81.90	85.36	88.03	89.00	89.42	89.86	89.29	88.10	88.14	89.52	90.76	91.23	91.42	91.81	92.21
32.5 N	91.80	92.34	91.55	89.33	87.53	84.44	80.47	79.56	81.24	82.71	85.04	88.70	90.49	90.38	90.84	90.77	89.72	90.35	92.06	92.22	92.02	92.47	92.62	92.67
30.0 N	92.02	92.26	92.64	90.97	88.71	86.12	81.82	79.29	81.11	84.27	86.80	89.83	91.91	91.55	91.23	91.83	91.79	91.88	92.70	92.89	92.88	93.18	93.03	92.90
27.5 N	92.02	91.77	92.65	92.26	91.10	90.20	85.66	79.12	78.02	82.67	87.83	91.02	92.74	93.19	92.80	92.51	92.39	92.18	92.75	93.66	93.69	93.53	93.73	93.68
25.0 N	92.68	92.12	92.20	92.37	91.74	91.99	91.12	85.33	78.56	78.63	85.99	92.86	93.37	92.94	94.11	94.16	93.75	93.60	93.49	94.02	94.11	93.87	94.20	94.20

April

	125.0 W	122.5 W	120.0 W	117.5 W	115.0 W	112.5 W	110.0 W	107.5 W	105.0 W	102.5 W	100.0 W	97.5 W	95.0 W	92.5 W	90.0 W	87.5 W	85.0 W	82.5 W	80.0 W	77.5 W	75.0 W	72.5 W	70.0 W	67.5 W
50.0 N	86.43	84.22	82.39	81.23	81.54	83.52	85.80	86.63	86.27	86.52	87.62	88.07	87.47	87.00	87.20	87.49	87.59	87.75	87.87	87.54	86.85	86.27	86.11	86.52
47.5 N	90.40	89.05	87.26	85.03	82.65	81.90	83.47	85.38	85.97	86.29	87.46	88.29	87.78	87.07	87.22	87.69	87.71	87.51	87.55	87.70	87.56	87.14	86.91	87.35
45.0 N	90.40	87.50	85.10	83.57	81.13	78.79	79.10	81.63	83.87	85.15	86.36	87.53	88.08	88.06	87.95	88.00	88.12	88.22	88.28	88.05	87.53	87.29	87.57	88.04
42.5 N	89.98	85.26	81.80	81.38	81.21	79.46	77.90	78.37	80.79	83.93	86.16	87.50	88.64	89.20	88.81	88.58	88.84	88.78	88.48	88.17	87.76	87.94	88.87	89.45
40.0 N	90.85	87.16	81.86	78.91	79.27	80.02	78.65	76.99	78.29	82.37	86.00	87.74	89.13	90.11	90.07	90.18	90.21	89.03	88.24	88.99	89.66	89.75	90.15	90.38
37.5 N	91.89	90.59	84.45	78.33	77.40	78.97	78.44	76.80	77.84	81.88	85.89	87.94	89.18	90.43	91.05	91.11	90.46	89.01	88.70	90.25	91.36	91.19	91.25	91.59
35.0 N	91.50	91.91	88.64	84.04	82.38	81.33	78.58	77.05	78.41	81.62	85.65	88.86	90.09	90.82	91.67	91.20	89.95	89.93	91.05	91.90	92.00	91.80	91.94	92.27
32.5 N	91.11	91.87	91.47	88.99	86.39	82.83	78.78	77.76	79.65	81.94	85.30	89.54	91.44	91.55	92.39	92.49	91.36	91.69	92.86	92.69	92.35	92.61	92.55	92.51
30.0 N	91.26	91.55	92.34	90.78	87.66	84.39	80.03	77.48	79.54	83.85	87.55	90.92	93.04	92.83	92.55	93.01	92.74	92.44	92.93	93.06	92.96	93.13	92.96	92.79
27.5 N	91.27	90.82	92.07	92.12	90.46	88.96	84.51	77.94	76.83	82.43	88.81	92.22	93.74	94.23	93.72	93.18	92.83	92.39	92.87	93.85	93.67	93.30	93.58	93.60
25.0 N	91.84	91.24	91.53	92.14	91.55	91.75	91.19	85.35	78.04	78.35	86.75	94.06	94.27	93.82	95.03	94.85	94.19	93.79	93.56	94.08	94.07	93.72	93.94	93.87

July

	125.0 W	122.5 W	120.0 W	117.5 W	115.0 W	112.5 W	110.0 W	107.5 W	105.0 W	102.5 W	100.0 W	97.5 W	95.0 W	92.5 W	90.0 W	87.5 W	85.0 W	82.5 W	80.0 W	77.5 W	75.0 W	72.5 W	70.0 W	67.5 W
50.0 N	88.59	86.20	84.37	83.41	83.92	86.01	88.31	88.99	88.59	89.06	90.55	91.38	91.07	90.75	90.99	91.25	91.30	91.47	91.69	91.50	90.91	90.38	90.29	90.74
47.5 N	91.87	89.96	88.32	86.51	84.24	83.43	85.06	87.19	88.16	89.00	90.67	91.92	91.69	90.87	90.67	90.97	91.03	90.89	91.09	91.62	91.85	91.58	91.26	91.39
45.0 N	91.45	87.77	85.54	84.29	81.60	78.97	79.46	82.62	85.96	88.30	89.85	91.07	92.01	92.25	91.76	91.29	91.14	91.14	91.42	91.78	91.69	91.42	91.35	91.24
42.5 N	90.49	84.69	81.09	80.71	80.02	77.93	76.67	78.20	82.65	87.94	90.84	91.61	92.64	93.40	92.75	92.14	92.22	91.96	91.70	91.81	91.72	91.96	92.89	93.33
40.0 N	91.44	86.25	80.39	77.45	77.31	77.68	76.68	76.22	79.77	86.42	91.05	92.19	93.15	94.11	93.95	94.21	94.45	92.99	92.00	93.06	94.06	94.28	94.66	94.61
37.5 N	92.79	90.64	83.81	77.75	76.46	77.56	77.08	76.23	78.95	84.96	89.97	92.01	93.30	94.67	95.27	95.40	94.76	93.24	93.14	95.03	96.11	95.65	95.42	95.36
35.0 N	92.11	92.57	89.07	84.41	82.49	81.23	78.71	78.01	80.68	84.96	89.25	92.57	94.05	95.02	95.97	95.45	94.18	94.46	96.05	96.94	96.47	95.74	96.06	96.06
32.5 N	91.52	92.43	92.47	89.81	86.69	83.38	80.39	80.87	84.03	86.28	88.74	92.72	95.04	95.63	96.65	96.76	96.00	96.64	97.42	96.67	96.08	96.14	95.99	95.95
30.0 N	91.64	92.12	93.23	91.87	88.27	85.46	82.66	81.95	85.22	88.58	90.38	93.31	96.11	96.52	96.21	96.49	97.14	97.59	96.92	95.81	95.15	95.80	95.59	95.59
27.5 N	92.04	91.54	93.09	93.47	92.01	91.25	88.42	83.90	83.67	87.56	91.27	93.95	95.95	96.78	96.14	95.35	96.16	97.23	96.83	96.12	95.65	95.33	95.45	95.50
25.0 N	92.90	92.40	92.80	93.63	93.52	94.46	95.29	92.16	86.45	84.87	90.27	96.44	96.58	95.77	96.84	96.40	96.03	96.65	96.22	95.82	95.64	95.35	95.50	95.35

October

	125.0 W	122.5 W	120.0 W	117.5 W	115.0 W	112.5 W	110.0 W	107.5 W	105.0 W	102.5 W	100.0 W	97.5 W	95.0 W	92.5 W	90.0 W	87.5 W	85.0 W	82.5 W	80.0 W	77.5 W	75.0 W	72.5 W	70.0 W	67.5 W

<tbl_r cells="25" ix="5" maxcspan="1

ECM 1991 - 2000 Range Error 1° Elevation (m)

United States

January

	125.0 W	122.5 W	120.0 W	117.5 W	115.0 W	112.5 W	110.0 W	107.5 W	105.0 W	102.5 W	100.0 W	97.5 W	95.0 W	92.5 W	90.0 W	87.5 W	85.0 W	82.5 W	80.0 W	77.5 W	75.0 W	72.5 W	70.0 W	67.5 W
50.0 N	61.60	60.18	59.01	58.27	58.42	59.59	60.97	61.49	61.33	61.57	62.29	62.61	62.31	62.04	62.08	62.19	62.28	62.46	62.55	62.31	61.84	61.45	61.35	61.57
47.5 N	64.27	63.34	62.21	60.82	59.30	58.76	59.70	60.83	61.13	61.35	62.13	62.65	62.39	62.01	62.05	62.21	62.15	62.06	62.16	62.28	62.18	61.89	61.74	62.04
45.0 N	64.35	62.33	60.77	59.93	58.38	56.74	56.87	58.45	59.85	60.72	61.51	62.10	62.32	62.39	62.42	62.44	62.45	62.47	62.50	62.38	62.07	61.91	62.11	62.48
42.5 N	64.09	60.89	58.73	58.80	58.82	57.45	56.19	56.38	57.94	60.02	61.50	62.08	62.50	62.78	62.59	62.51	62.73	62.74	62.55	62.36	62.14	62.31	62.98	63.40
40.0 N	64.77	62.42	59.09	57.51	57.98	58.24	56.92	55.54	56.28	59.05	61.40	62.26	62.84	63.27	63.12	63.22	63.36	62.68	62.20	62.75	63.26	63.44	63.80	63.96
37.5 N	65.53	64.84	61.03	57.44	57.29	58.35	57.42	55.81	56.35	59.07	61.58	62.50	62.93	63.45	63.67	63.75	63.45	62.54	62.35	63.44	64.31	64.41	64.60	64.86
35.0 N	65.29	65.60	63.69	61.29	61.02	60.52	58.21	56.84	57.60	59.48	61.66	63.24	63.69	63.87	64.14	63.78	63.02	63.05	63.91	64.62	64.84	64.92	65.14	65.39
32.5 N	65.19	65.59	65.22	63.97	63.03	61.13	58.49	58.02	59.20	59.96	61.26	63.57	64.56	64.37	64.70	64.68	63.97	64.36	65.42	65.41	65.23	65.53	65.60	65.62
30.0 N	65.34	65.48	65.78	64.78	63.49	62.07	59.38	57.79	59.13	61.15	62.48	64.18	65.33	64.94	64.74	65.20	65.18	65.19	65.66	65.70	65.67	65.88	65.76	65.66
27.5 N	65.28	65.09	65.71	65.51	64.87	64.56	61.79	57.41	56.78	60.06	63.24	64.84	65.67	65.89	65.59	65.40	65.35	65.21	65.54	66.09	66.07	65.97	66.10	66.06
25.0 N	65.67	65.29	65.34	65.47	65.06	65.33	65.02	61.56	57.12	57.18	62.02	65.98	65.85	65.54	66.33	66.32	66.07	65.98	65.86	66.18	66.20	66.03	66.26	66.26

April

	125.0 W	122.5 W	120.0 W	117.5 W	115.0 W	112.5 W	110.0 W	107.5 W	105.0 W	102.5 W	100.0 W	97.5 W	95.0 W	92.5 W	90.0 W	87.5 W	85.0 W	82.5 W	80.0 W	77.5 W	75.0 W	72.5 W	70.0 W	67.5 W
50.0 N	62.03	60.65	59.49	58.78	59.03	60.42	61.97	62.44	62.08	62.20	62.90	63.16	62.71	62.40	62.56	62.73	62.75	62.83	62.91	62.69	62.25	61.89	61.80	62.05
47.5 N	64.64	63.96	62.98	61.60	60.00	59.46	60.54	61.81	62.06	62.14	62.89	63.40	62.97	62.44	62.56	62.88	62.86	62.68	62.70	62.82	62.76	62.49	62.29	62.54
45.0 N	64.59	62.82	61.42	60.57	58.92	57.22	57.49	59.33	60.80	61.49	62.16	62.86	63.16	63.11	63.02	63.04	63.11	63.16	63.22	63.08	62.72	62.53	62.68	62.94
42.5 N	64.30	61.27	59.17	59.18	59.22	57.96	56.79	57.11	58.76	60.78	62.13	62.83	63.48	63.79	63.49	63.31	63.51	63.51	63.33	63.12	62.80	62.88	63.49	63.83
40.0 N	64.84	62.65	59.29	57.44	57.86	58.50	57.51	56.20	57.00	59.78	62.08	63.00	63.78	64.34	64.21	64.30	64.42	63.66	63.11	63.61	64.00	63.97	64.21	64.32
37.5 N	65.38	64.82	60.95	56.81	56.25	57.61	57.34	56.15	56.81	59.50	62.02	63.09	63.73	64.46	64.79	64.86	64.53	63.59	63.33	64.30	64.98	64.79	64.82	65.03
35.0 N	65.00	65.41	63.52	60.65	59.83	59.30	57.39	56.33	57.26	59.32	61.85	63.72	64.27	64.61	65.11	64.81	64.04	64.07	64.76	65.23	65.24	65.09	65.17	65.39
32.5 N	64.70	65.21	65.10	63.73	62.34	60.16	57.44	56.86	58.16	59.49	61.45	64.03	65.02	64.94	65.49	65.58	64.85	65.07	65.80	65.60	65.35	65.55	65.50	65.47
30.0 N	64.78	64.94	65.48	64.59	62.80	60.96	58.24	56.63	58.15	60.92	62.96	64.78	65.89	65.58	65.39	65.76	65.63	65.43	65.70	65.72	65.64	65.78	65.66	65.54
27.5 N	64.73	64.39	65.22	65.33	64.41	63.75	61.05	56.66	56.00	59.92	63.85	65.48	66.14	66.35	65.97	65.63	65.48	65.23	65.54	66.14	65.99	65.75	65.96	65.98
25.0 N	65.06	64.66	64.83	65.24	64.88	65.13	65.04	61.60	56.80	57.00	62.51	66.63	66.24	65.91	66.71	66.57	66.19	65.97	65.80	66.14	66.12	65.88	66.06	66.02

July

	125.0 W	122.5 W	120.0 W	117.5 W	115.0 W	112.5 W	110.0 W	107.5 W	105.0 W	102.5 W	100.0 W	97.5 W	95.0 W	92.5 W	90.0 W	87.5 W	85.0 W	82.5 W	80.0 W	77.5 W	75.0 W	72.5 W	70.0 W	67.5 W
50.0 N	63.36	61.95	60.85	60.28	60.64	62.06	63.53	63.85	63.43	63.65	64.53	64.97	64.70	64.51	64.70	64.86	64.86	64.94	65.08	64.96	64.61	64.32	64.29	64.57
47.5 N	65.44	64.48	63.69	62.63	61.12	60.53	61.63	62.98	63.39	63.73	64.69	65.38	65.10	64.52	64.42	64.66	64.70	64.57	64.67	65.01	65.19	65.04	64.83	64.89
45.0 N	65.12	63.00	61.81	61.20	59.36	57.47	57.84	60.06	62.15	63.39	64.11	64.70	65.21	65.34	65.04	64.78	64.71	64.71	64.89	65.11	65.02	64.83	64.76	64.63
42.5 N	64.53	60.90	58.84	58.90	58.56	57.05	56.10	57.08	60.03	63.33	64.86	65.01	65.53	65.96	65.49	65.10	65.23	65.13	65.00	65.05	64.90	64.99	65.59	65.84
40.0 N	65.00	62.02	58.40	56.56	56.64	57.02	56.30	55.80	58.04	62.41	65.08	65.39	65.80	66.27	66.04	66.23	66.52	65.68	65.04	65.70	66.23	66.26	66.49	66.43
37.5 N	65.71	64.73	60.55	56.49	55.74	56.77	56.51	55.84	57.57	61.45	64.36	65.24	65.80	66.49	66.75	66.86	66.60	65.67	65.55	66.68	67.28	66.93	66.79	66.76
35.0 N	65.10	65.62	63.69	60.89	59.96	59.31	57.54	56.99	58.73	61.37	63.88	65.61	66.20	66.59	67.08	66.78	66.07	66.30	67.24	67.70	67.35	66.88	66.91	67.14
32.5 N	64.72	65.33	65.55	64.14	62.48	60.51	58.52	58.90	60.99	62.17	63.37	65.61	66.73	66.88	67.51	67.62	67.14	67.53	67.95	67.42	67.06	67.11	67.03	67.05
30.0 N	64.80	65.10	65.84	65.12	63.02	61.51	59.86	59.50	61.72	63.71	64.40	65.90	67.36	67.41	67.23	67.45	67.84	68.08	67.60	66.89	66.92	67.14	66.94	66.85
27.5 N	65.04	64.65	65.71	66.02	65.18	64.96	63.31	60.39	60.36	62.96	64.98	66.18	67.14	67.54	67.17	66.69	67.23	67.89	67.62	67.17	66.87	66.65	66.76	66.83
25.0 N	65.57	65.22	65.46	66.01																				

ECM 1991 - 2000 Range Error 3° Elevation (m)

United States

January

	125.0 W	122.5 W	120.0 W	117.5 W	115.0 W	112.5 W	110.0 W	107.5 W	105.0 W	102.5 W	100.0 W	97.5 W	95.0 W	92.5 W	90.0 W	87.5 W	85.0 W	82.5 W	80.0 W	77.5 W	75.0 W	72.5 W	70.0 W	67.5 W
50.0 N	37.05	36.35	35.75	35.37	35.47	36.12	36.86	37.07	36.92	37.01	37.37	37.50	37.31	37.16	37.18	37.21	37.23	37.30	37.33	37.21	36.98	36.79	36.74	36.85
47.5 N	38.40	38.05	37.57	36.89	36.07	35.75	36.27	36.86	36.92	36.96	37.35	37.60	37.41	37.18	37.20	37.27	37.21	37.14	37.18	37.25	37.22	37.06	36.96	37.09
45.0 N	38.44	37.51	36.79	36.42	35.56	34.59	34.69	35.63	36.34	36.71	37.07	37.33	37.41	37.43	37.42	37.47	37.40	37.41	37.35	37.19	37.10	37.18	37.35	37.35
42.5 N	38.35	36.75	35.66	35.86	35.94	35.13	34.37	34.48	35.35	36.44	37.14	37.35	37.53	37.65	37.51	37.45	37.57	37.57	37.48	37.38	37.24	37.31	37.65	37.84
40.0 N	38.66	37.61	35.92	35.11	35.46	35.65	34.88	34.02	34.40	35.94	37.13	37.47	37.72	37.91	37.79	37.83	37.93	37.58	37.33	37.61	37.83	37.88	38.04	38.11
37.5 N	38.93	38.77	36.93	34.95	34.93	35.64	35.14	34.18	34.46	35.97	37.25	37.60	37.76	38.00	38.06	38.11	38.00	37.54	37.42	37.95	38.32	38.40	38.52	38.52
35.0 N	38.77	39.00	38.22	37.06	37.03	36.85	35.55	34.76	35.19	36.18	37.28	38.01	38.13	38.17	38.29	38.13	37.77	37.79	38.18	38.47	38.53	38.54	38.64	38.75
32.5 N	38.71	38.91	38.81	38.32	37.99	37.09	35.66	35.45	36.13	36.41	37.00	38.13	38.50	38.35	38.52	38.53	38.18	38.36	38.81	38.76	38.67	38.81	38.83	38.83
30.0 N	38.78	38.83	38.97	38.59	38.09	37.50	36.15	35.31	36.11	37.13	37.65	38.37	38.77	38.53	38.45	38.69	38.68	38.67	38.84	38.82	38.91	38.85	38.81	38.81
27.5 N	38.73	38.63	38.90	38.83	38.61	38.63	37.38	35.02	34.71	36.57	38.08	38.59	38.83	38.88	38.75	38.68	38.68	38.61	38.73	38.93	38.91	38.87	38.93	38.91
25.0 N	38.86	38.69	38.70	38.76	38.59	38.74	38.77	37.27	34.90	34.92	37.54	39.08	38.80	38.66	38.97	38.95	38.86	38.84	38.77	38.89	38.88	38.81	38.90	38.90

April

	125.0 W	122.5 W	120.0 W	117.5 W	115.0 W	112.5 W	110.0 W	107.5 W	105.0 W	102.5 W	100.0 W	97.5 W	95.0 W	92.5 W	90.0 W	87.5 W	85.0 W	82.5 W	80.0 W	77.5 W	75.0 W	72.5 W	70.0 W	67.5 W
50.0 N	37.29	36.61	36.03	35.67	35.83	36.61	37.44	37.63	37.39	37.42	37.77	37.87	37.62	37.47	37.56	37.63	37.61	37.63	37.66	37.55	37.34	37.17	37.12	37.24
47.5 N	38.58	38.35	37.97	37.32	36.46	36.16	36.77	37.43	37.47	37.45	37.82	38.05	37.79	37.49	37.55	37.72	37.69	37.57	37.57	37.64	37.63	37.49	37.36	37.46
45.0 N	38.56	37.76	37.12	36.76	35.85	34.87	35.06	36.15	36.91	37.17	37.45	37.77	37.89	37.84	37.78	37.78	37.80	37.82	37.85	37.79	37.60	37.49	37.55	37.65
42.5 N	38.44	36.95	35.89	36.06	36.16	35.41	34.71	34.90	35.83	36.88	37.50	37.76	38.03	38.16	37.98	37.88	37.99	37.99	37.91	37.81	37.63	37.65	37.94	38.08
40.0 N	38.67	37.72	36.04	35.08	35.41	35.81	35.22	34.41	34.83	36.35	37.50	37.84	38.16	38.39	38.28	38.32	38.42	38.07	37.80	38.05	38.20	38.15	38.24	38.27
37.5 N	38.83	38.74	36.89	34.60	34.33	35.23	35.12	34.41	34.76	36.23	37.48	37.88	38.11	38.41	38.53	38.57	38.47	38.03	37.88	38.33	38.60	38.47	38.48	38.58
35.0 N	38.59	38.86	38.12	36.73	36.41	36.22	35.13	34.51	35.05	36.14	37.39	38.21	38.35	38.44	38.65	38.52	38.19	38.22	38.52	38.69	38.66	38.58	38.61	38.72
32.5 N	38.43	38.65	38.67	38.17	37.65	36.61	35.13	34.85	35.60	36.20	37.12	38.32	38.65	38.53	38.78	38.83	38.50	38.61	38.91	38.77	38.66	38.76	38.73	38.72
30.0 N	38.44	38.48	38.71	38.42	37.73	36.94	35.58	34.71	35.62	37.06	37.89	38.59	38.94	38.73	38.65	38.83	38.78	38.70	38.80	38.78	38.74	38.80	38.76	38.71
27.5 N	38.38	38.21	38.56	38.64	38.34	38.23	37.01	34.63	34.29	36.52	38.37	38.82	38.95	38.98	38.79	38.66	38.64	38.55	38.68	38.90	38.82	38.72	38.82	38.83
25.0 N	38.49	38.32	38.37	38.55	38.43	38.59	38.74	37.31	34.75	34.84	37.79	39.31	38.89	38.72	38.99	38.91	38.80	38.74	38.68	38.81	38.80	38.70	38.78	38.77

July

	125.0 W	122.5 W	120.0 W	117.5 W	115.0 W	112.5 W	110.0 W	107.5 W	105.0 W	102.5 W	100.0 W	97.5 W	95.0 W	92.5 W	90.0 W	87.5 W	85.0 W	82.5 W	80.0 W	77.5 W	75.0 W	72.5 W	70.0 W	67.5 W
50.0 N	37.97	37.34	36.81	36.53	36.74	37.48	38.19	38.28	38.01	38.08	38.45	38.59	38.43	38.35	38.45	38.52	38.50	38.53	38.58	38.54	38.40	38.29	38.29	38.40
47.5 N	38.86	38.57	38.34	37.89	37.11	36.79	37.38	38.02	38.10	38.16	38.55	38.80	38.61	38.33	38.30	38.43	38.45	38.37	38.39	38.54	38.63	38.57	38.48	38.49
45.0 N	38.74	37.88	37.42	37.20	36.19	35.12	35.37	36.60	37.61	38.07	38.28	38.46	38.63	38.67	38.54	38.44	38.43	38.50	38.59	38.54	38.45	38.41	38.34	38.34
42.5 N	38.48	36.82	35.83	36.03	35.91	35.01	34.44	34.97	36.54	38.15	38.69	38.58	38.73	38.88	38.66	38.50	38.59	38.57	38.52	38.55	38.45	38.46	38.78	38.78
40.0 N	38.62	37.42	35.64	34.69	34.82	35.09	34.65	34.26	35.48	37.75	38.82	38.75	38.83	38.96	38.80	38.87	39.05	38.74	38.49	38.78	38.95	38.90	38.97	38.93
37.5 N	38.78	38.60	36.74	34.52	34.13	34.85	34.74	34.29	35.23	37.26	38.50	38.67	38.79	38.98	39.00	39.06	39.03	38.70	38.64	39.08	39.24	39.06	39.01	39.00
35.0 N	38.43	38.80	38.14	36.90	36.54	36.27	35.25	34.90	35.86	37.18	38.26	38.83	38.90	38.95	39.10	39.03	38.80	38.92	39.26	39.37	39.19	39.00	39.01	39.12
32.5 N	38.27	38.54	38.74	38.28	37.70	36.80	35.72	35.95	37.08	37.53	37.94	38.81	39.09	39.05	39.28	39.36	39.20	39.35	39.45	39.20	39.05	39.06	39.04	39.09
30.0 N	38.30	38.44	38.76	38.55	37.77	37.18	36.38	36.21	37.42	38.28	38.38	38.88	39.30	39.24	39.21	39.32	39.48	39.55	39.32	39.01	38.99	39.06	39.01	39.02
27.5 N	38.42	38.22	38.70	38.87	38.58	38.66	38.04	36.56	36.59	37.90	38.66	38.95	39.18	39.27	39.16	39.02	39.27	39.53	39.38	39.15	39.01	38.92	38.97	39.03
25.0 N	38.63	38.48	38.58	38.83	38.82	39.18	39.60	38.96	37.45	36.90	38.43	39.60	39.25	39.04	39.32	39.25	39.21	39.39	39.25	39.09	39.00	38.91	38.97	38.97

October

	125.0 W	122.5 W	120.0 W	117.5 W	115.0 W	112.5 W	110.0 W	107.5 W	105.0 W	102.5 W	100.0 W	97.5 W	95.0 W	92.5 W	90.0 W	87.5 W	85.0 W	82.5 W	80.0 W	77.5 W	75.0 W	72.5 W	70.0 W	67.5 W

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ECM 1991 - 2000 Range Error 5° Elevation (m)

United States

January

	125.0 W	122.5 W	120.0 W	117.5 W	115.0 W	112.5 W	110.0 W	107.5 W	105.0 W	102.5 W	100.0 W	97.5 W	95.0 W	92.5 W	90.0 W	87.5 W	85.0 W	82.5 W	80.0 W	77.5 W	75.0 W	72.5 W	70.0 W	67.5 W
50.0 N	25.65	25.22	24.84	24.59	24.65	25.07	25.53	25.65	25.54	25.60	25.81	25.88	25.76	25.66	25.67	25.68	25.68	25.71	25.73	25.65	25.51	25.39	25.36	25.41
47.5 N	26.41	26.23	25.96	25.55	25.03	24.83	25.17	25.54	25.56	25.57	25.81	25.95	25.83	25.69	25.69	25.73	25.69	25.64	25.66	25.70	25.67	25.57	25.51	25.58
45.0 N	26.48	25.95	25.50	25.29	24.74	24.09	24.16	24.78	25.23	25.44	25.65	25.81	25.85	25.85	25.84	25.82	25.81	25.80	25.81	25.77	25.68	25.62	25.67	25.77
42.5 N	26.46	25.51	24.80	24.94	25.01	24.46	23.95	24.03	24.60	25.30	25.72	25.83	25.93	26.00	25.91	25.86	25.93	25.93	25.87	25.81	25.77	25.73	25.96	26.07
40.0 N	26.62	26.06	24.99	24.45	24.69	24.82	24.31	23.72	23.98	24.99	25.73	25.91	26.05	26.15	26.08	26.09	26.15	25.95	25.81	25.97	26.09	26.12	26.21	26.24
37.5 N	26.74	26.69	25.64	24.35	24.34	24.83	24.50	23.83	24.01	25.02	25.81	26.01	26.09	26.22	26.25	26.27	26.22	25.95	25.88	26.19	26.38	26.37	26.41	26.48
35.0 N	26.66	26.76	26.40	25.71	25.69	25.58	24.74	24.22	24.51	25.15	25.83	26.25	26.31	26.33	26.39	26.31	26.11	26.12	26.33	26.47	26.49	26.51	26.56	26.61
32.5 N	26.64	26.71	26.67	26.44	26.26	25.73	24.82	24.68	25.12	25.29	25.67	26.33	26.50	26.42	26.50	26.51	26.34	26.43	26.63	26.61	26.58	26.64	26.65	26.66
30.0 N	26.66	26.67	26.73	26.58	26.33	26.00	25.17	24.60	25.11	25.75	26.06	26.45	26.61	26.50	26.47	26.57	26.64	26.57	26.64	26.64	26.69	26.66	26.64	26.64
27.5 N	26.64	26.58	26.68	26.65	26.56	26.60	25.95	24.44	24.21	25.43	26.32	26.55	26.61	26.63	26.58	26.56	26.55	26.59	26.66	26.66	26.65	26.66	26.66	26.66
25.0 N	26.67	26.59	26.58	26.60	26.53	26.59	26.63	25.89	24.38	24.38	26.06	26.75	26.59	26.54	26.63	26.61	26.60	26.60	26.57	26.60	26.61	26.58	26.60	26.61

April

	125.0 W	122.5 W	120.0 W	117.5 W	115.0 W	112.5 W	110.0 W	107.5 W	105.0 W	102.5 W	100.0 W	97.5 W	95.0 W	92.5 W	90.0 W	87.5 W	85.0 W	82.5 W	80.0 W	77.5 W	75.0 W	72.5 W	70.0 W	67.5 W
50.0 N	25.81	25.40	25.03	24.79	24.90	25.40	25.92	26.03	25.87	25.89	26.10	26.15	26.00	25.90	25.95	25.99	25.97	25.98	26.00	25.93	25.79	25.69	25.65	25.72
47.5 N	26.52	26.41	26.20	25.82	25.29	25.11	25.51	25.92	25.93	25.91	26.13	26.26	26.10	25.92	25.95	26.05	26.02	25.95	25.95	25.98	25.97	25.88	25.80	25.85
45.0 N	26.55	26.10	25.72	25.51	24.94	24.28	24.42	25.14	25.61	25.76	25.93	26.11	26.17	26.13	26.09	26.09	26.09	26.10	26.12	26.08	25.96	25.90	25.93	25.98
42.5 N	26.51	25.64	24.95	25.07	25.14	24.65	24.18	24.32	24.93	25.59	25.96	26.10	26.25	26.31	26.20	26.14	26.21	26.21	26.16	26.11	26.00	26.00	26.16	26.23
40.0 N	26.62	26.12	25.06	24.43	24.65	24.92	24.53	23.98	24.26	25.27	25.75	26.15	26.32	26.43	26.37	26.39	26.44	26.26	26.11	26.25	26.32	26.28	26.33	26.34
37.5 N	26.67	26.66	25.63	24.12	23.94	24.56	24.49	23.99	24.22	25.19	25.96	26.18	26.30	26.45	26.50	26.52	26.48	26.25	26.17	26.40	26.52	26.44	26.45	26.50
35.0 N	26.54	26.65	26.33	25.51	25.31	25.19	24.48	24.07	24.43	25.14	25.91	26.36	26.43	26.47	26.57	26.51	26.35	26.36	26.50	26.57	26.55	26.51	26.53	26.58
32.5 N	26.46	26.53	26.54	26.33	26.06	25.43	24.48	24.30	24.80	25.18	25.76	26.43	26.57	26.50	26.61	26.63	26.49	26.54	26.66	26.59	26.55	26.59	26.58	26.58
30.0 N	26.43	26.43	26.52	26.43	26.11	25.66	24.80	24.22	24.82	25.72	26.20	26.55	26.67	26.57	26.54	26.62	26.60	26.57	26.61	26.59	26.58	26.60	26.58	26.57
27.5 N	26.38	26.31	26.43	26.46	26.38	26.37	25.73	24.19	23.94	25.42	26.48	26.65	26.66	26.64	26.56	26.52	26.52	26.50	26.54	26.62	26.58	26.55	26.58	26.59
25.0 N	26.40	26.34	26.35	26.43	26.39	26.46	26.57	25.91	24.29	24.34	26.21	26.84	26.62	26.53	26.56	26.52	26.50	26.50	26.49	26.53	26.54	26.51	26.53	26.53

July

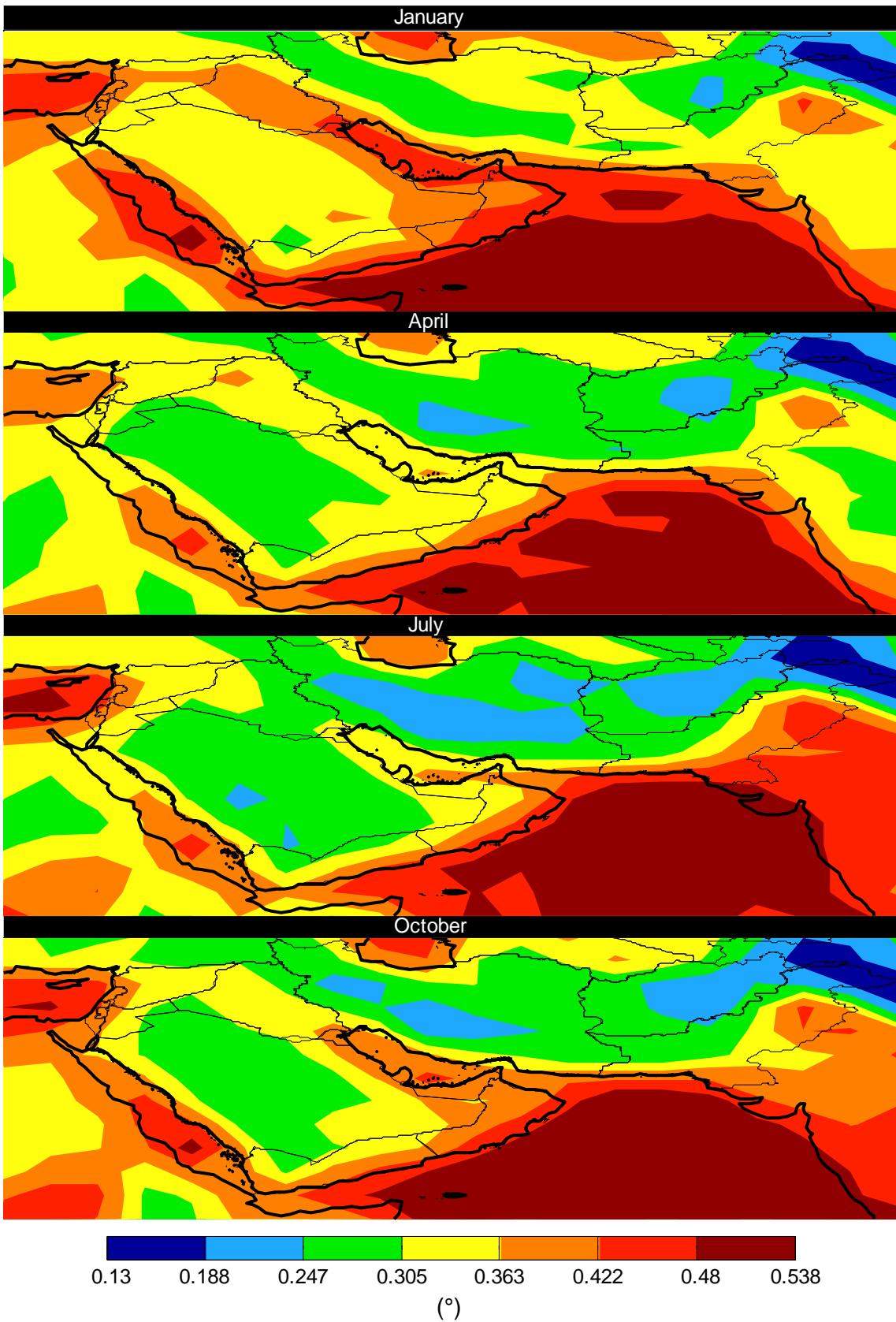
	125.0 W	122.5 W	120.0 W	117.5 W	115.0 W	112.5 W	110.0 W	107.5 W	105.0 W	102.5 W	100.0 W	97.5 W	95.0 W	92.5 W	90.0 W	87.5 W	85.0 W	82.5 W	80.0 W	77.5 W	75.0 W	72.5 W	70.0 W	67.5 W
50.0 N	26.26	25.90	25.57	25.39	25.51	25.97	26.38	26.42	26.26	26.30	26.48	26.54	26.45	26.40	26.45	26.48	26.46	26.47	26.50	26.48	26.42	26.37	26.36	26.40
47.5 N	26.65	26.53	26.43	26.20	25.73	25.54	25.92	26.29	26.32	26.34	26.53	26.63	26.53	26.39	26.38	26.44	26.45	26.41	26.42	26.47	26.51	26.48	26.44	26.44
45.0 N	26.62	26.21	25.94	25.82	25.19	24.49	24.66	25.47	26.07	26.32	26.41	26.48	26.53	26.53	26.47	26.43	26.43	26.44	26.47	26.50	26.44	26.42	26.39	26.39
42.5 N	26.52	25.61	24.96	25.10	25.02	24.43	24.04	24.40	25.43	26.38	26.62	26.53	26.57	26.62	26.52	26.46	26.50	26.50	26.48	26.50	26.45	26.45	26.55	26.55
40.0 N	26.53	25.98	24.85	24.21	24.30	24.50	24.20	23.92	24.74	26.17	26.70	26.61	26.63	26.65	26.56	26.58	26.66	26.66	26.61	26.64	26.65	26.65	26.62	26.60
37.5 N	26.54	26.54	25.56	24.10	23.84	24.34	24.26	23.94	24.57	25.88	26.55	26.58	26.60	26.64	26.61	26.64	26.66	26.55	26.53	26.70	26.73	26.64	26.62	26.62
35.0 N	26.36	26.53	26.32	25.63	25.40	25.23	24.57	24.35	24.98	25.82	26.41	26.64	26.62	26.61	26.65	26.66	26.61	26.66	26.78	26.77	26.69	26.62	26.62	26.65
32.5 N	26.29	26.40	26.50	26.35	26.08	25.56	24.87	25.03	25.74	26.01	26.24	26.63	26.70	26.66	26.74	26.79	26.78	26.83	26.80	26.70	26.63	26.61	26.61	26.66
30.0 N	26.30	26.36	26.50	26.44	26.13	25.82	25.32	25.20	25.94	26.44	26.65	26.76	26.76	26.73	26.68	26.73	26.72	26.73	26.72	26.72	26.72	26.67	26.60	26.65
27.5 N	26.36	26.28	26.49	26.57	26.46	26.55	26.32	25.46	25.46	26.23	26.59	26.68	26.73	26.72	26.73	26.74	26.78	26.85	26.79	26.69	26.62	26.58	26.61	26.64
25.0 N	26.45	26.40	26.45	26.57																				

Appendix B

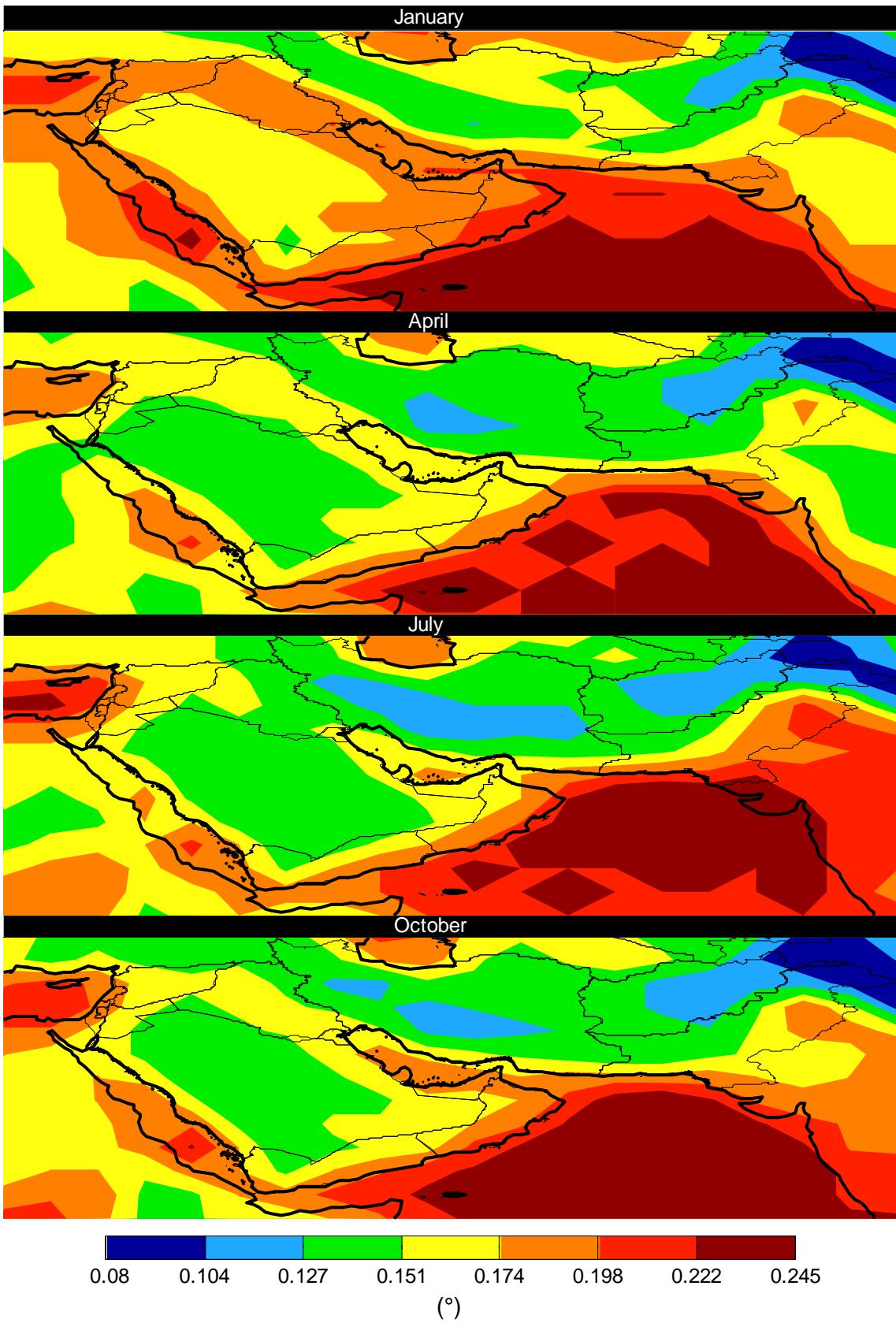
**ECM 1991-2000 ANGLE ERRORS
JANUARY, APRIL, JULY, OCTOBER
0, 1, 3, AND 5° ELEVATION ANGLES**

**MIDDLE EAST
AMAZON RAINFOREST
NORTH ASIA
SOUTH ASIA**

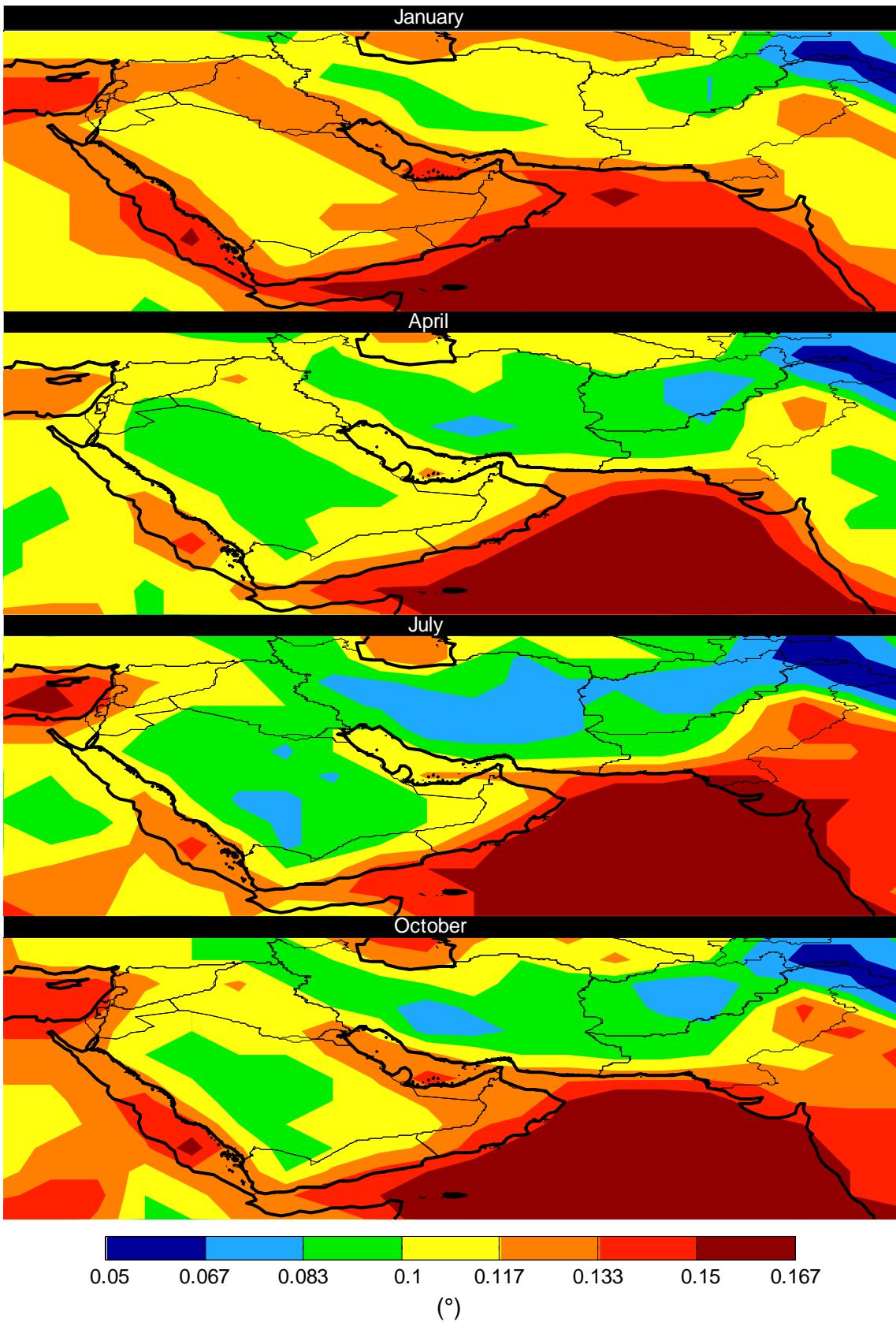
ECM 1991-2000 Angle Error 0° Elevation
Middle East



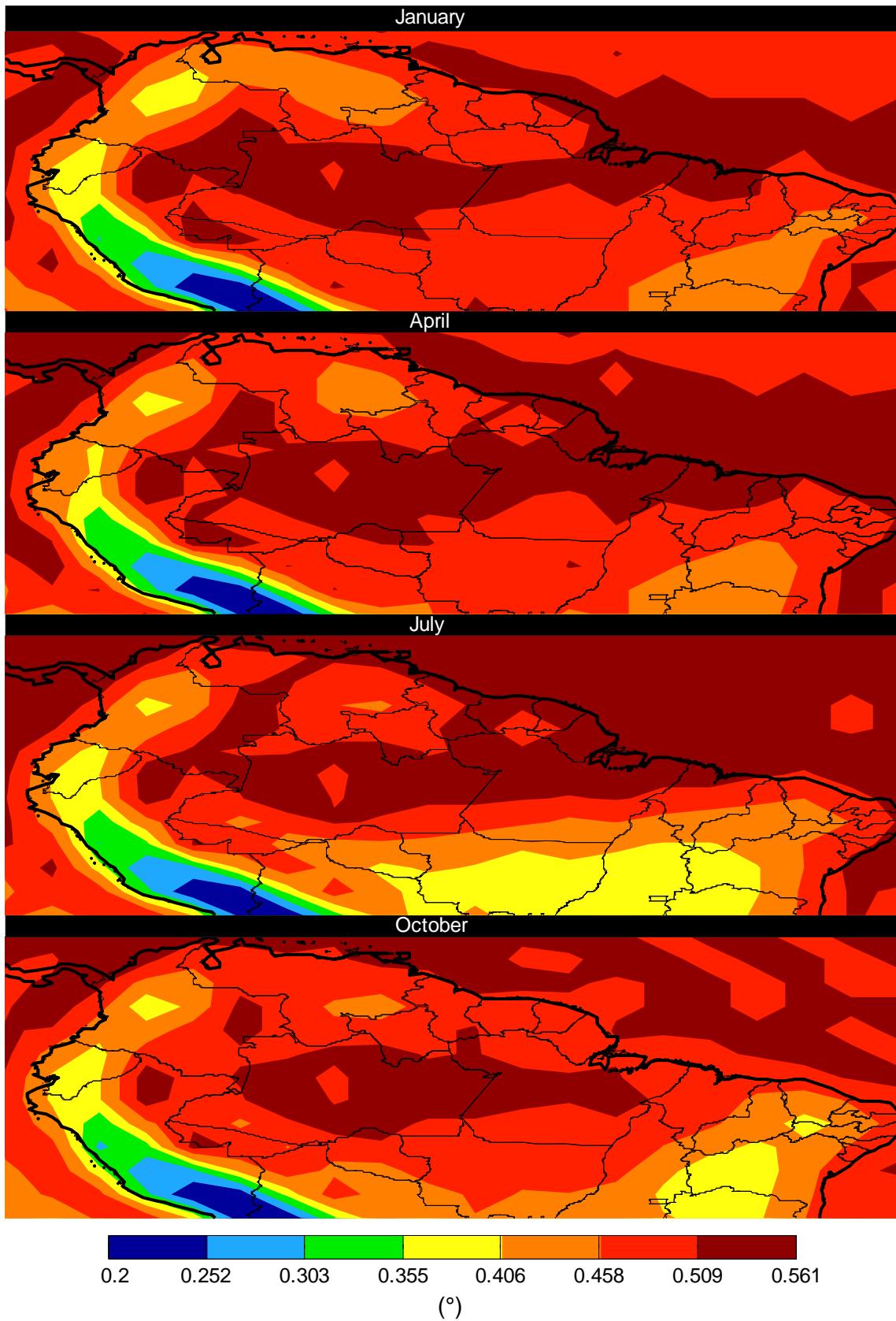
ECM 1991-2000 Angle Error 3° Elevation
Middle East



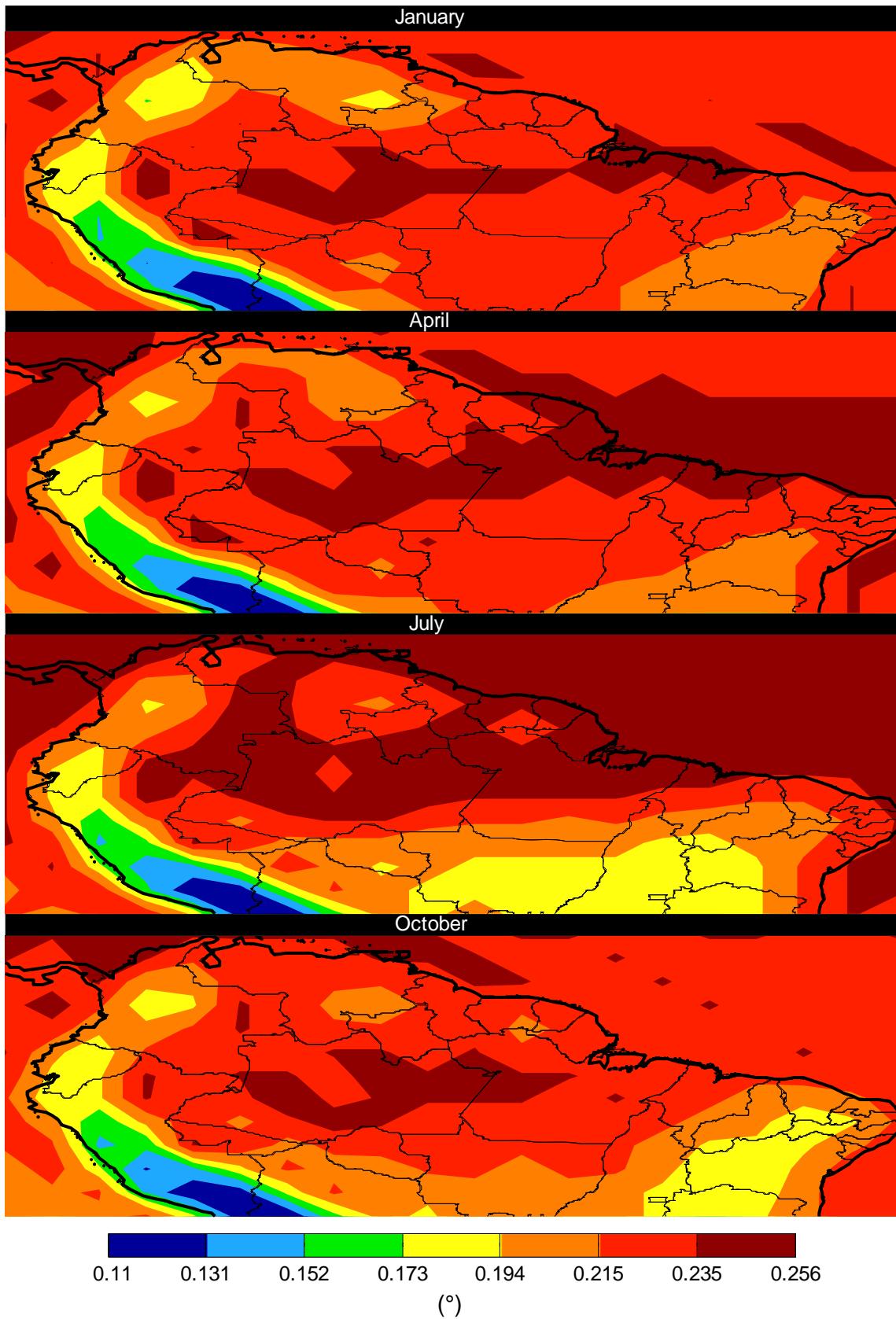
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Middle East



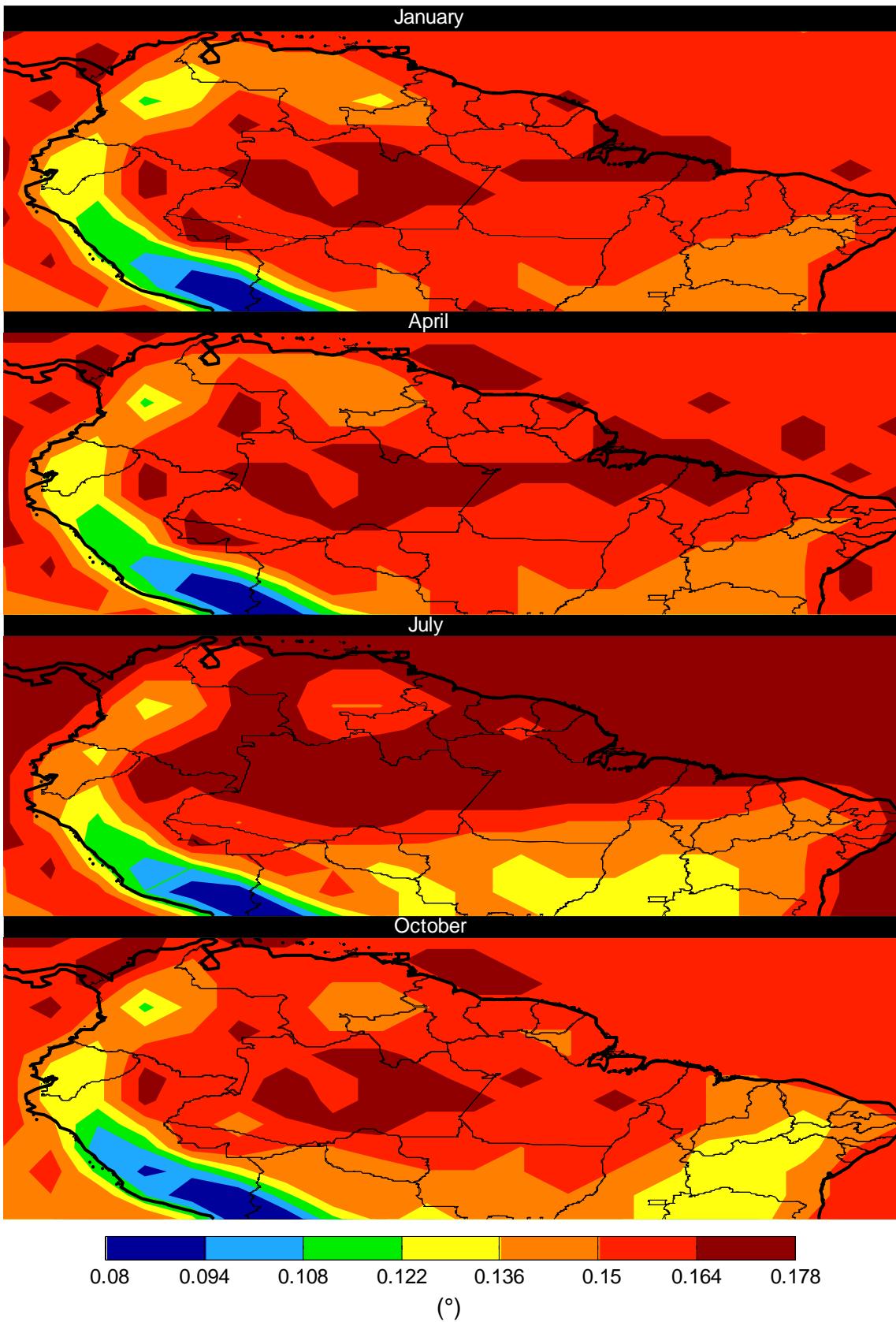
ECM 1991-2000 Angle Error 0° Elevation
Amazon Rainforest



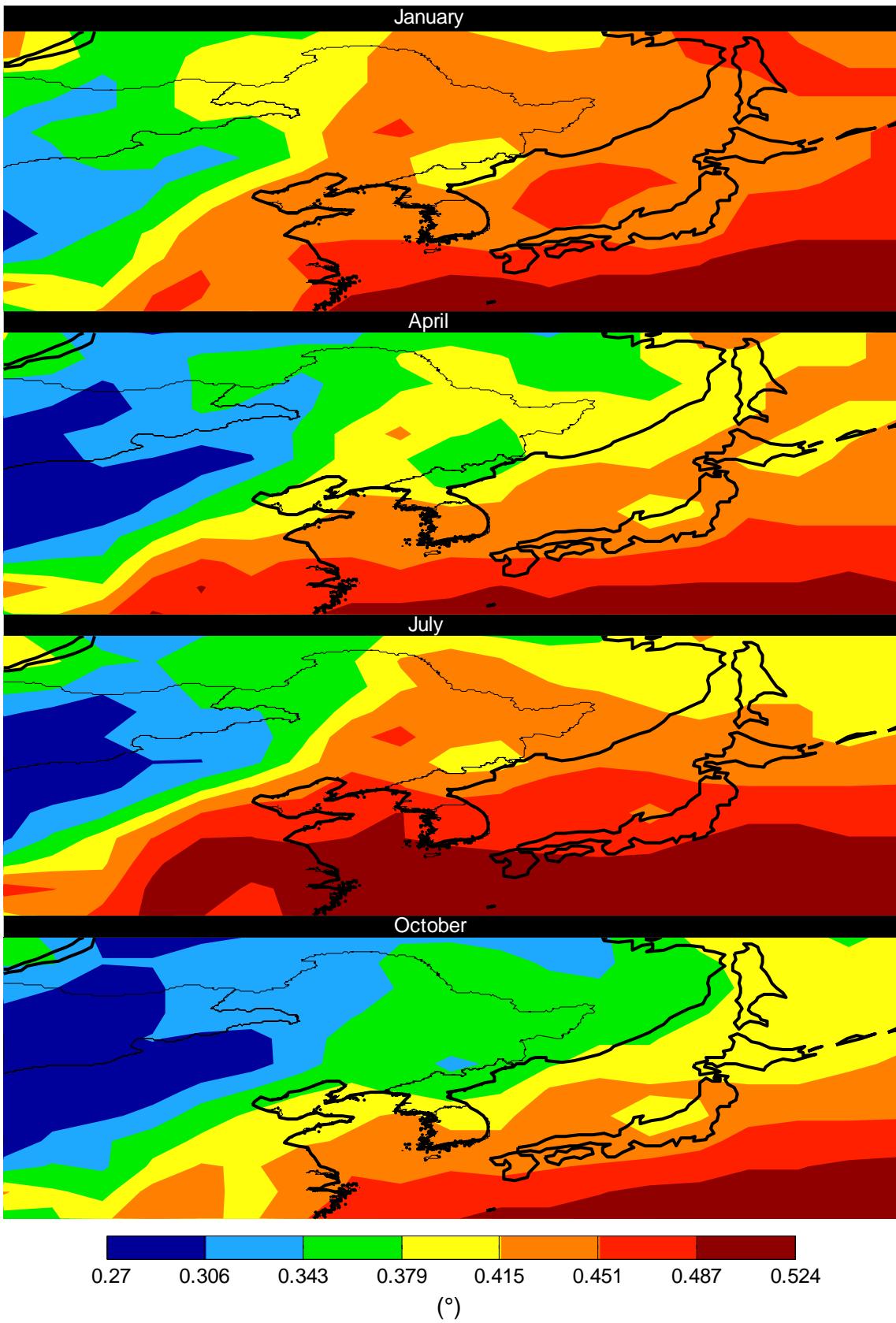
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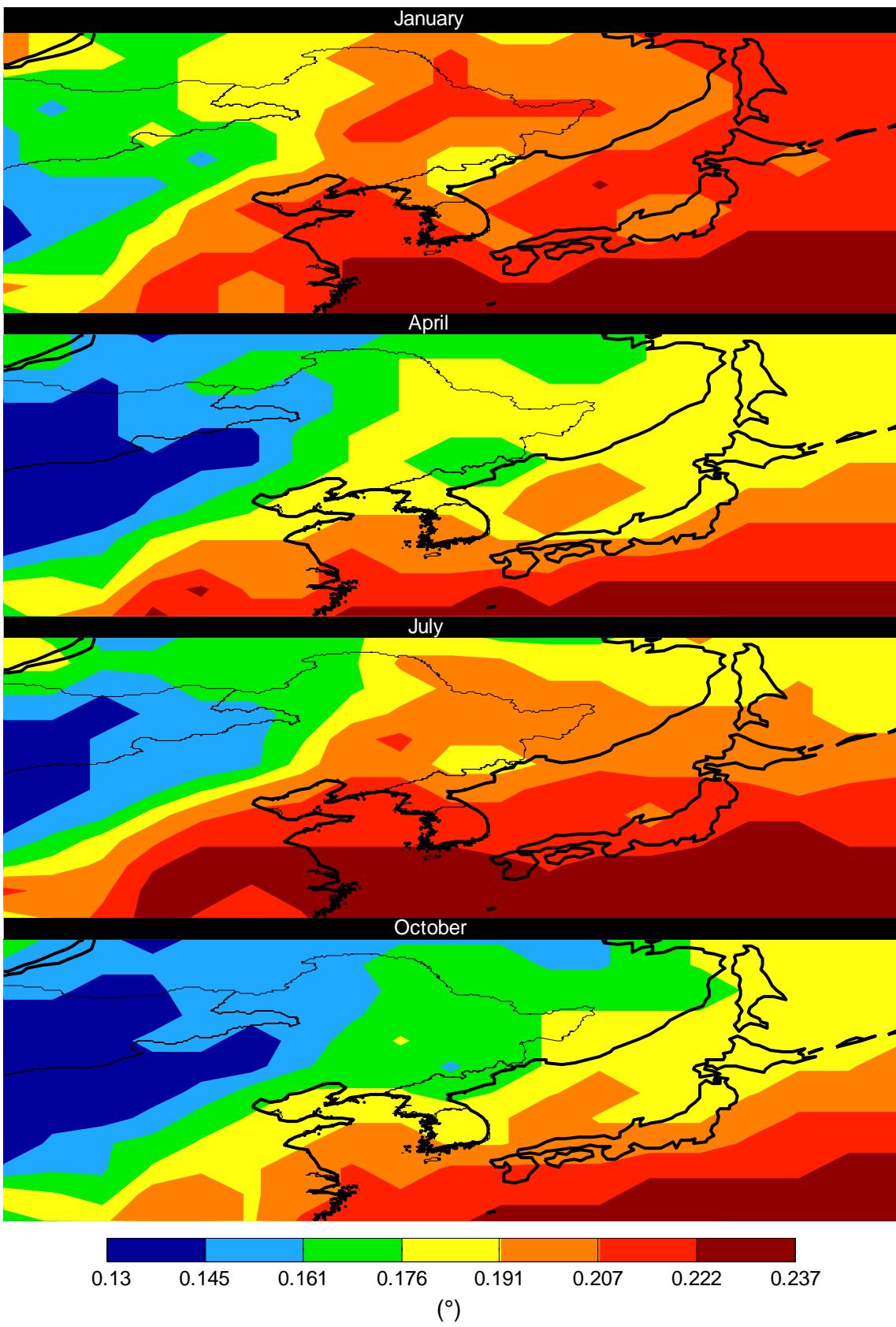
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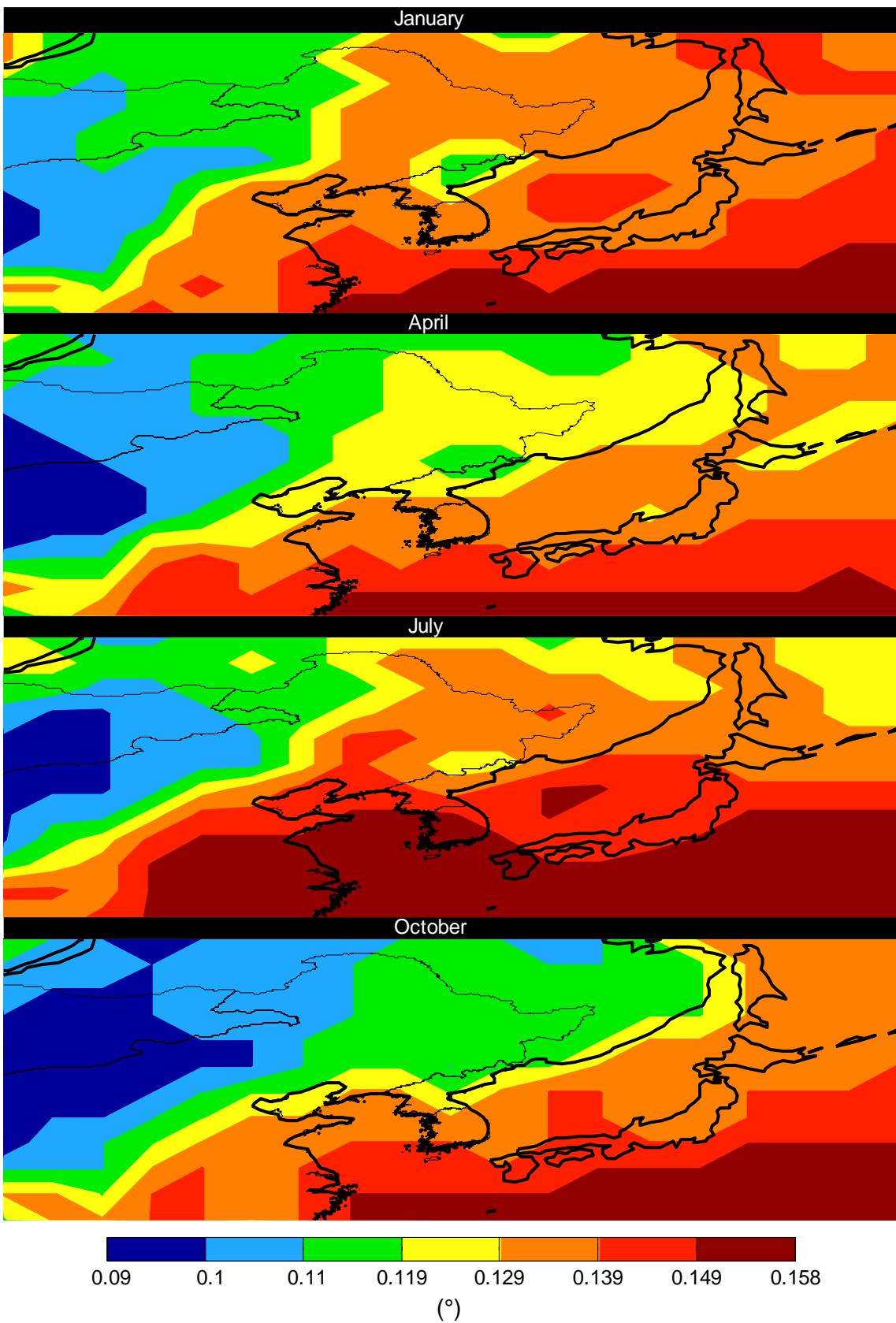
ECM 1991-2000 Angle Error 0° Elevation
North Asia



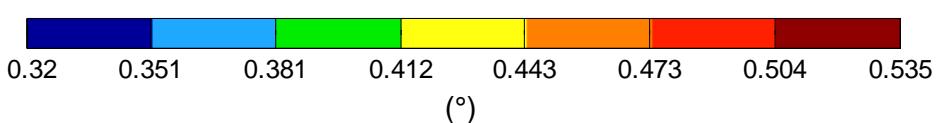
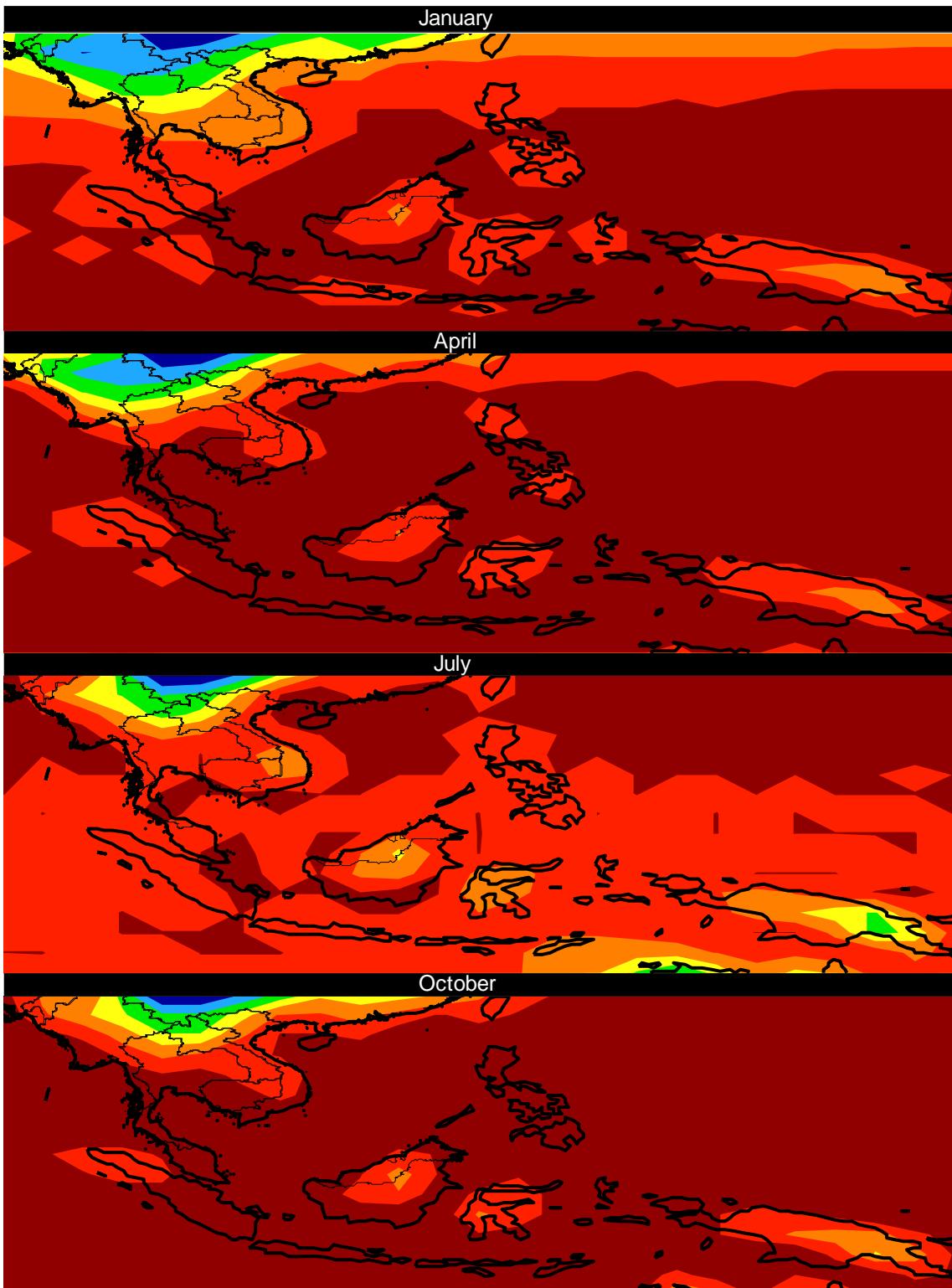
ECM 1991-2000 Angle Error 3° Elevation
North Asia



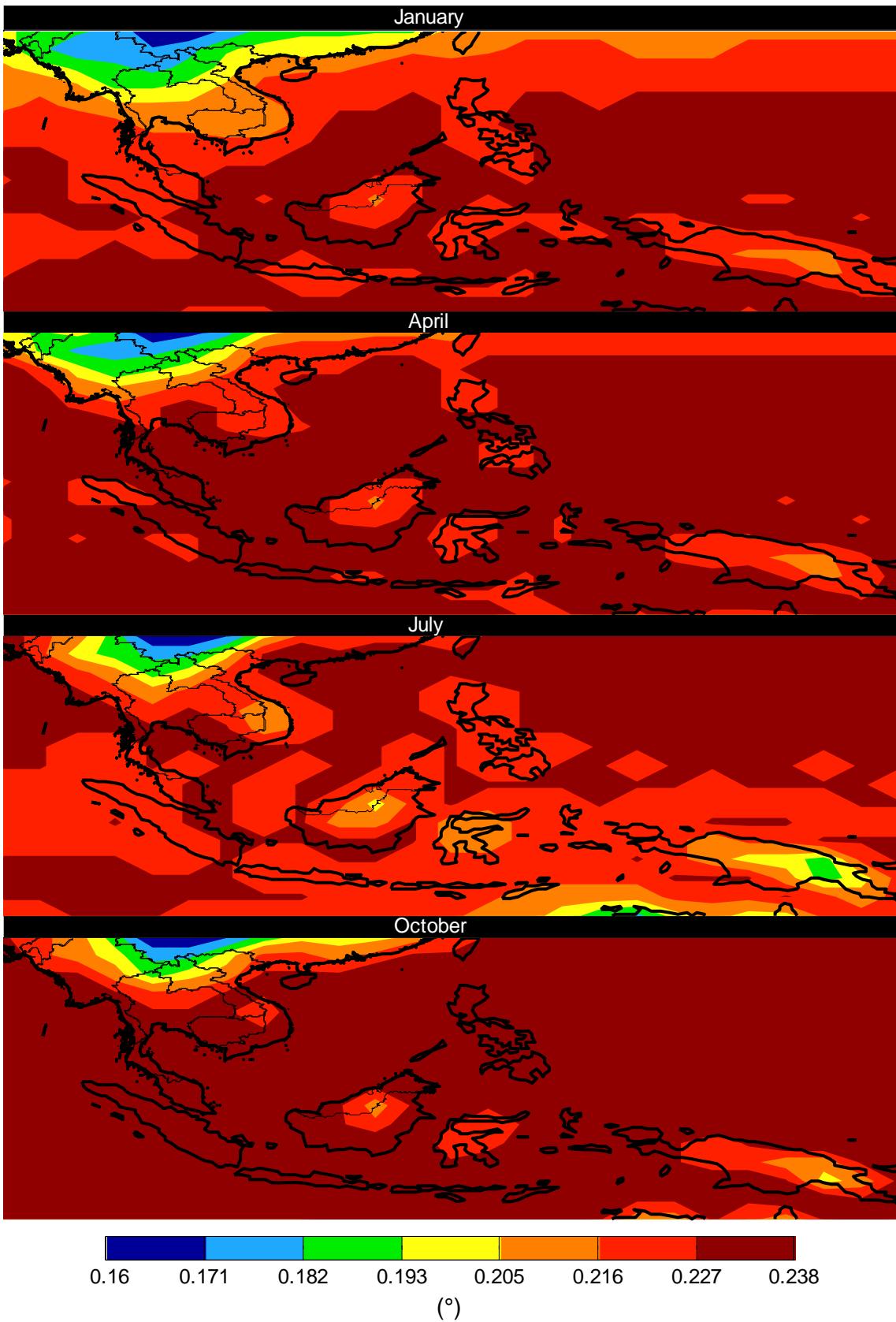
ECM 1991-2000 Angle Error 5° Elevation
North Asia



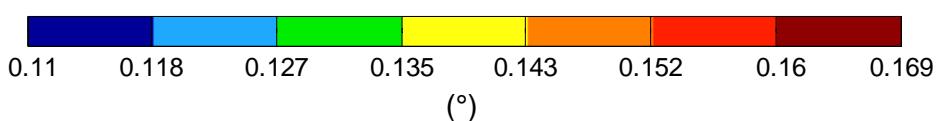
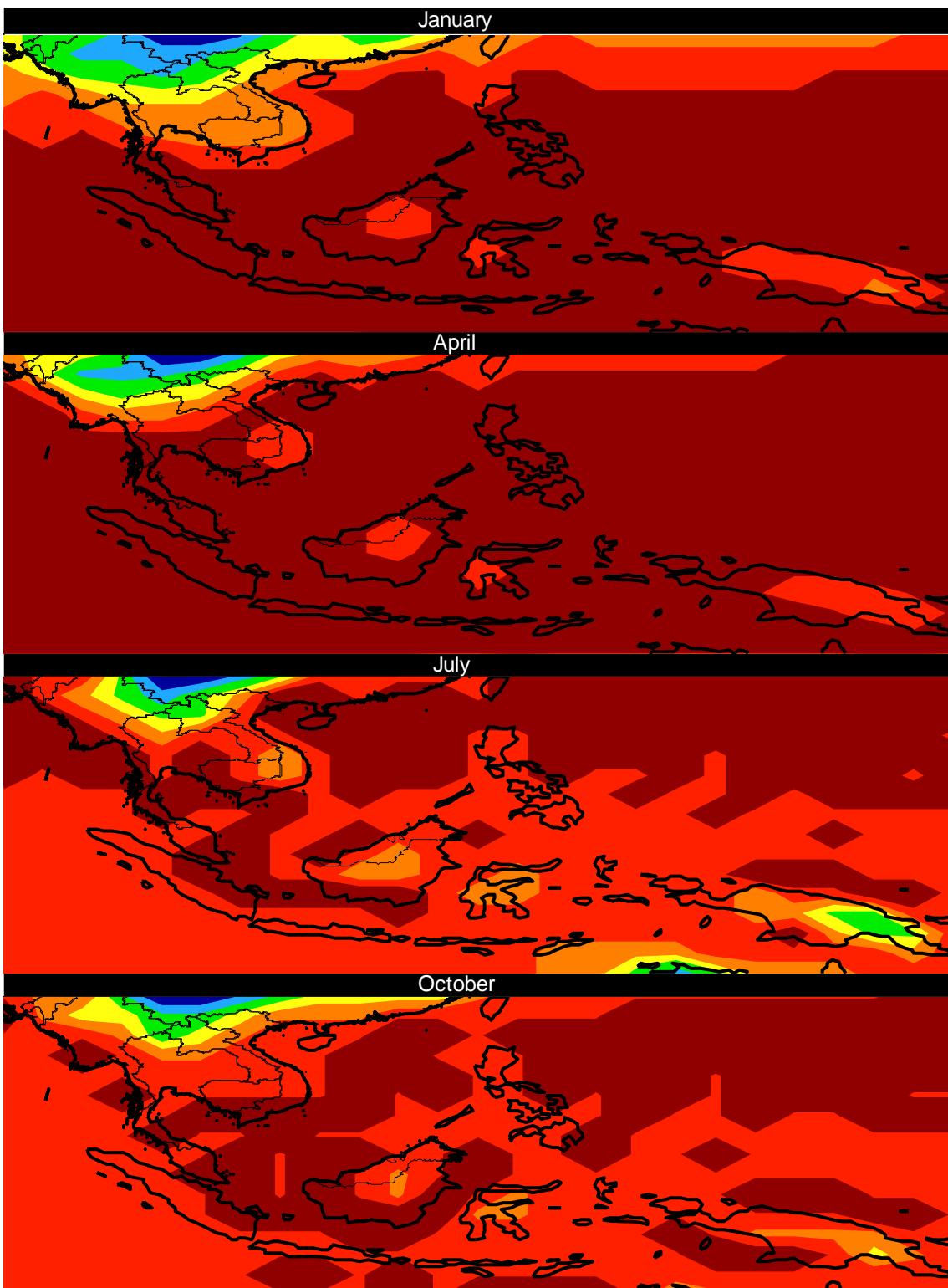
ECM 1991-2000 Angle Error 0° Elevation
South Asia



ECM 1991-2000 Angle Error 3° Elevation
South Asia



ECM 1991-2000 Angle Error 5° Elevation
South Asia



ECM 1991 - 2000 Angle Error 0° Elevation (°)

Middle East

January

	30.0 E	32.5 E	35.0 E	37.5 E	40.0 E	42.5 E	45.0 E	47.5 E	50.0 E	52.5 E	55.0 E	57.5 E	60.0 E	62.5 E	65.0 E	67.5 E	70.0 E	72.5 E	75.0 E	77.5 E
40.0 N	0.35	0.30	0.31	0.31	0.29	0.26	0.26	0.33	0.41	0.42	0.36	0.37	0.39	0.37	0.35	0.35	0.28	0.20	0.20	0.27
37.5 N	0.34	0.32	0.33	0.33	0.33	0.29	0.28	0.35	0.39	0.34	0.30	0.34	0.38	0.37	0.32	0.23	0.16	0.17	0.23	
35.0 N	0.40	0.41	0.41	0.36	0.36	0.39	0.34	0.26	0.25	0.30	0.33	0.30	0.28	0.30	0.26	0.23	0.25	0.25	0.18	0.13
32.5 N	0.42	0.42	0.39	0.32	0.32	0.37	0.38	0.36	0.29	0.25	0.30	0.32	0.31	0.33	0.27	0.21	0.30	0.41	0.33	0.19
30.0 N	0.39	0.38	0.35	0.32	0.32	0.34	0.36	0.42	0.38	0.26	0.24	0.27	0.29	0.34	0.33	0.28	0.32	0.38	0.38	0.34
27.5 N	0.36	0.35	0.35	0.32	0.31	0.32	0.36	0.42	0.38	0.34	0.34	0.30	0.28	0.29	0.31	0.33	0.32	0.32	0.36	
25.0 N	0.35	0.35	0.40	0.38	0.31	0.32	0.33	0.32	0.37	0.43	0.41	0.41	0.39	0.37	0.37	0.36	0.33	0.32	0.32	
22.5 N	0.35	0.33	0.38	0.44	0.36	0.30	0.32	0.33	0.34	0.38	0.38	0.37	0.42	0.46	0.46	0.43	0.37	0.34	0.34	
20.0 N	0.35	0.33	0.35	0.44	0.43	0.32	0.31	0.36	0.35	0.36	0.40	0.43	0.45	0.44	0.44	0.45	0.44	0.38	0.32	0.34
17.5 N	0.32	0.34	0.36	0.41	0.49	0.36	0.27	0.32	0.34	0.36	0.43	0.47	0.48	0.47	0.47	0.46	0.47	0.43	0.33	0.34
15.0 N	0.29	0.33	0.35	0.32	0.40	0.39	0.32	0.38	0.42	0.45	0.48	0.47	0.47	0.49	0.48	0.47	0.48	0.39	0.38	
12.5 N	0.29	0.32	0.34	0.27	0.33	0.42	0.44	0.48	0.48	0.49	0.50	0.49	0.51	0.48	0.49	0.50	0.51	0.42	0.38	
10.0 N	0.31	0.33	0.34	0.27	0.30	0.37	0.38	0.40	0.44	0.49	0.50	0.49	0.51	0.50	0.50	0.51	0.50	0.48	0.45	

April

	30.0 E	32.5 E	35.0 E	37.5 E	40.0 E	42.5 E	45.0 E	47.5 E	50.0 E	52.5 E	55.0 E	57.5 E	60.0 E	62.5 E	65.0 E	67.5 E	70.0 E	72.5 E	75.0 E	77.5 E	
40.0 N	0.35	0.31	0.32	0.33	0.30	0.27	0.28	0.34	0.42	0.41	0.35	0.35	0.38	0.34	0.33	0.35	0.29	0.20	0.21	0.27	
37.5 N	0.35	0.33	0.34	0.34	0.35	0.35	0.31	0.30	0.36	0.38	0.32	0.30	0.34	0.37	0.36	0.33	0.24	0.16	0.17	0.24	
35.0 N	0.41	0.42	0.41	0.36	0.37	0.40	0.34	0.26	0.30	0.32	0.29	0.27	0.29	0.26	0.24	0.27	0.26	0.19	0.13		
32.5 N	0.44	0.44	0.38	0.31	0.30	0.34	0.36	0.34	0.28	0.25	0.29	0.30	0.29	0.31	0.25	0.21	0.32	0.44	0.34	0.20	
30.0 N	0.38	0.37	0.33	0.29	0.30	0.31	0.32	0.38	0.35	0.23	0.22	0.25	0.27	0.31	0.30	0.26	0.32	0.39	0.38	0.33	
27.5 N	0.33	0.32	0.32	0.29	0.28	0.30	0.30	0.34	0.38	0.34	0.31	0.31	0.27	0.25	0.26	0.30	0.33	0.31	0.31	0.34	
25.0 N	0.32	0.32	0.36	0.35	0.29	0.30	0.31	0.30	0.34	0.39	0.37	0.37	0.39	0.40	0.40	0.41	0.39	0.34	0.31	0.30	
22.5 N	0.32	0.30	0.36	0.41	0.33	0.27	0.30	0.31	0.31	0.34	0.33	0.35	0.45	0.53	0.54	0.52	0.44	0.36	0.32	0.31	
20.0 N	0.31	0.31	0.33	0.42	0.42	0.30	0.29	0.29	0.35	0.33	0.33	0.38	0.44	0.51	0.50	0.50	0.53	0.52	0.40	0.31	0.31
17.5 N	0.30	0.32	0.33	0.40	0.49	0.36	0.27	0.32	0.33	0.36	0.45	0.51	0.53	0.52	0.51	0.52	0.53	0.46	0.33	0.32	
15.0 N	0.28	0.33	0.35	0.32	0.40	0.38	0.31	0.39	0.45	0.49	0.52	0.50	0.50	0.51	0.53	0.52	0.53	0.53	0.40	0.37	
12.5 N	0.32	0.37	0.39	0.30	0.32	0.40	0.42	0.48	0.50	0.52	0.53	0.51	0.53	0.51	0.53	0.54	0.54	0.58	0.48	0.40	
10.0 N	0.40	0.41	0.40	0.31	0.31	0.37	0.37	0.39	0.44	0.50	0.51	0.50	0.53	0.52	0.53	0.54	0.52	0.54	0.54	0.50	

July

	30.0 E	32.5 E	35.0 E	37.5 E	40.0 E	42.5 E	45.0 E	47.5 E	50.0 E	52.5 E	55.0 E	57.5 E	60.0 E	62.5 E	65.0 E	67.5 E	70.0 E	72.5 E	75.0 E	77.5 E
40.0 N	0.36	0.33	0.35	0.36	0.33	0.31	0.29	0.35	0.44	0.43	0.34	0.33	0.35	0.32	0.30	0.31	0.26	0.20	0.22	0.29
37.5 N	0.34	0.33	0.36	0.34	0.33	0.33	0.29	0.31	0.41	0.44	0.32	0.27	0.32	0.35	0.33	0.30	0.23	0.16	0.19	0.27
35.0 N	0.46	0.50	0.49	0.39	0.35	0.35	0.30	0.24	0.26	0.31	0.30	0.26	0.26	0.27	0.24	0.23	0.28	0.27	0.20	0.15
32.5 N	0.53	0.54	0.47	0.36	0.32	0.34	0.32	0.30	0.25	0.22	0.26	0.28	0.27	0.29	0.24	0.24	0.37	0.49	0.39	0.23
30.0 N	0.45	0.43	0.38	0.32	0.31	0.31	0.30	0.35	0.32	0.22	0.21	0.24	0.25	0.29	0.30	0.31	0.40	0.49	0.43	
27.5 N	0.36	0.36	0.35	0.30	0.28	0.28	0.27	0.32	0.38	0.34	0.31	0.30	0.28	0.27	0.30	0.37	0.44	0.44	0.45	0.51
25.0 N	0.34	0.33	0.37	0.36	0.29	0.28	0.29	0.27	0.34	0.41	0.40	0.40	0.44	0.47	0.48	0.49	0.50	0.48	0.47	0.47
22.5 N	0.33	0.30	0.35	0.41	0.32	0.25	0.28	0.28	0.29	0.34	0.34	0.34	0.38	0.50	0.58	0.58	0.56	0.52	0.50	0.49
20.0 N	0.32	0.30	0.31	0.39	0.40	0.29	0.27	0.31	0.30	0.32	0.38	0.46	0.53	0.52	0.54	0.55	0.53	0.48	0.48	
17.5 N	0.32	0.35	0.35	0.39	0.49	0.39	0.26	0.29	0.32	0.37	0.47	0.53	0.54	0.53	0.53	0.53	0.53	0.48	0.46	
15.0 N	0.36	0.41	0.44	0.37	0.43	0.41	0.31	0.38	0.46	0.50	0.53	0.51	0.51	0.51	0.53	0.52	0.51	0.53	0.49	
12.5 N	0.42	0.43	0.45	0.34	0.35	0.42	0.40	0.45	0.47	0.49	0.51	0.50	0.53	0.52	0.51	0.52	0.52	0.53	0.49	
10.0 N	0.47	0.43	0.40	0.32	0.34	0.39	0.35	0.34	0.38	0.47	0.52	0.50	0.52	0.52	0.52	0.51	0.51	0.52	0.51	

October

	30.0 E	32.5 E	35.0 E	37.5 E	40.0 E	42.5 E	45.0 E	47.5 E	50.0 E	52.5 E	55.0 E	57.5 E	60.0 E	62.5 E	65.0 E	67.5 E	70.0 E	72.5 E	75.0 E	77.5 E
40.0 N	0.35	0.30	0.31	0.32	0.29	0.26	0.27	0.35	0.45	0.44	0.35	0.34	0.37	0.34	0.32	0.33	0.27	0.19	0.20	0.27
37.5 N	0.34	0.32	0.33	0.31	0.31															

ECM 1991 - 2000 Angle Error 3° Elevation (°)

Middle East

January

	30.0 E	32.5 E	35.0 E	37.5 E	40.0 E	42.5 E	45.0 E	47.5 E	50.0 E	52.5 E	55.0 E	57.5 E	60.0 E	62.5 E	65.0 E	67.5 E	70.0 E	72.5 E	75.0 E	77.5 E
40.0 N	0.16	0.15	0.15	0.15	0.14	0.13	0.13	0.16	0.19	0.19	0.17	0.17	0.18	0.17	0.17	0.16	0.13	0.10	0.11	0.13
37.5 N	0.16	0.15	0.16	0.16	0.16	0.16	0.14	0.14	0.16	0.18	0.16	0.15	0.16	0.18	0.17	0.15	0.12	0.09	0.09	0.11
35.0 N	0.19	0.19	0.19	0.17	0.17	0.18	0.16	0.13	0.13	0.15	0.16	0.15	0.14	0.14	0.13	0.12	0.12	0.12	0.10	0.08
32.5 N	0.19	0.19	0.18	0.16	0.16	0.17	0.18	0.17	0.14	0.13	0.14	0.15	0.15	0.16	0.13	0.11	0.14	0.18	0.15	0.10
30.0 N	0.18	0.18	0.16	0.15	0.15	0.16	0.17	0.19	0.17	0.13	0.12	0.13	0.14	0.16	0.15	0.14	0.15	0.18	0.18	0.16
27.5 N	0.17	0.17	0.17	0.15	0.15	0.15	0.15	0.17	0.19	0.18	0.16	0.16	0.15	0.14	0.14	0.15	0.16	0.15	0.15	0.17
25.0 N	0.16	0.16	0.18	0.18	0.15	0.15	0.16	0.15	0.15	0.17	0.19	0.19	0.19	0.18	0.17	0.17	0.17	0.16	0.15	0.15
22.5 N	0.16	0.16	0.18	0.20	0.17	0.15	0.15	0.16	0.16	0.18	0.18	0.18	0.20	0.21	0.21	0.20	0.18	0.16	0.16	0.16
20.0 N	0.16	0.16	0.17	0.20	0.20	0.15	0.15	0.17	0.17	0.17	0.19	0.20	0.21	0.20	0.20	0.21	0.20	0.18	0.15	0.16
17.5 N	0.15	0.16	0.17	0.19	0.22	0.17	0.14	0.14	0.16	0.17	0.20	0.21	0.22	0.22	0.22	0.22	0.22	0.20	0.18	0.18
15.0 N	0.14	0.16	0.16	0.16	0.19	0.18	0.15	0.18	0.19	0.21	0.21	0.22	0.22	0.22	0.22	0.22	0.22	0.20	0.18	0.18
12.5 N	0.14	0.15	0.16	0.14	0.16	0.19	0.20	0.21	0.22	0.22	0.22	0.22	0.23	0.22	0.22	0.23	0.22	0.23	0.20	0.18
10.0 N	0.15	0.16	0.16	0.14	0.14	0.17	0.18	0.19	0.20	0.22	0.23	0.22	0.23	0.23	0.23	0.23	0.23	0.22	0.21	0.21

April

	30.0 E	32.5 E	35.0 E	37.5 E	40.0 E	42.5 E	45.0 E	47.5 E	50.0 E	52.5 E	55.0 E	57.5 E	60.0 E	62.5 E	65.0 E	67.5 E	70.0 E	72.5 E	75.0 E	77.5 E
40.0 N	0.17	0.15	0.16	0.16	0.15	0.14	0.16	0.19	0.19	0.17	0.17	0.17	0.16	0.16	0.16	0.14	0.11	0.11	0.13	
37.5 N	0.17	0.16	0.16	0.16	0.17	0.16	0.15	0.17	0.18	0.15	0.14	0.16	0.17	0.17	0.15	0.12	0.09	0.09	0.11	
35.0 N	0.19	0.20	0.19	0.17	0.17	0.18	0.16	0.13	0.13	0.14	0.15	0.14	0.14	0.14	0.13	0.12	0.13	0.13	0.10	0.08
32.5 N	0.20	0.20	0.18	0.15	0.15	0.16	0.17	0.16	0.14	0.12	0.14	0.12	0.14	0.14	0.14	0.13	0.11	0.19	0.16	0.10
30.0 N	0.18	0.17	0.16	0.14	0.14	0.15	0.15	0.18	0.16	0.12	0.13	0.13	0.13	0.15	0.14	0.13	0.15	0.18	0.18	0.16
27.5 N	0.16	0.15	0.15	0.14	0.14	0.14	0.14	0.16	0.18	0.16	0.17	0.17	0.18	0.18	0.18	0.19	0.16	0.15	0.15	0.16
25.0 N	0.15	0.15	0.17	0.16	0.14	0.14	0.15	0.14	0.16	0.18	0.17	0.17	0.18	0.18	0.18	0.19	0.18	0.16	0.15	0.14
22.5 N	0.15	0.15	0.17	0.19	0.16	0.14	0.14	0.15	0.15	0.16	0.16	0.16	0.17	0.21	0.24	0.24	0.23	0.20	0.17	0.15
20.0 N	0.15	0.15	0.16	0.19	0.19	0.15	0.14	0.16	0.16	0.16	0.16	0.16	0.18	0.20	0.23	0.24	0.23	0.19	0.15	0.15
17.5 N	0.14	0.15	0.16	0.19	0.22	0.17	0.13	0.15	0.16	0.17	0.20	0.23	0.24	0.24	0.23	0.23	0.23	0.24	0.21	0.15
15.0 N	0.14	0.16	0.16	0.16	0.18	0.18	0.15	0.18	0.20	0.22	0.23	0.23	0.23	0.23	0.24	0.24	0.24	0.24	0.24	0.17
12.5 N	0.15	0.17	0.18	0.14	0.15	0.18	0.19	0.21	0.23	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.26	0.22	0.19
10.0 N	0.18	0.19	0.18	0.15	0.15	0.17	0.18	0.18	0.20	0.23	0.23	0.23	0.24	0.23	0.24	0.24	0.23	0.24	0.24	0.22

July

	30.0 E	32.5 E	35.0 E	37.5 E	40.0 E	42.5 E	45.0 E	47.5 E	50.0 E	52.5 E	55.0 E	57.5 E	60.0 E	62.5 E	65.0 E	67.5 E	70.0 E	72.5 E	75.0 E	77.5 E
40.0 N	0.17	0.16	0.17	0.17	0.16	0.15	0.14	0.16	0.20	0.20	0.16	0.16	0.16	0.15	0.15	0.13	0.10	0.11	0.14	
37.5 N	0.16	0.16	0.17	0.16	0.16	0.15	0.14	0.15	0.19	0.20	0.16	0.14	0.15	0.16	0.15	0.14	0.11	0.09	0.10	0.13
35.0 N	0.21	0.22	0.22	0.18	0.16	0.16	0.14	0.12	0.13	0.15	0.14	0.13	0.13	0.13	0.12	0.12	0.13	0.13	0.11	0.08
32.5 N	0.24	0.24	0.21	0.17	0.15	0.16	0.15	0.14	0.12	0.11	0.13	0.13	0.13	0.14	0.12	0.12	0.17	0.22	0.18	0.12
30.0 N	0.20	0.20	0.18	0.15	0.15	0.15	0.15	0.16	0.15	0.11	0.11	0.12	0.12	0.14	0.14	0.15	0.19	0.22	0.20	
27.5 N	0.17	0.17	0.16	0.15	0.14	0.14	0.13	0.15	0.17	0.16	0.15	0.15	0.14	0.14	0.15	0.17	0.20	0.20	0.21	0.23
25.0 N	0.16	0.16	0.17	0.17	0.14	0.14	0.14	0.14	0.16	0.19	0.18	0.18	0.20	0.21	0.22	0.22	0.23	0.22	0.22	0.22
22.5 N	0.16	0.15	0.16	0.19	0.15	0.13	0.13	0.14	0.14	0.16	0.16	0.16	0.18	0.23	0.26	0.26	0.25	0.24	0.23	0.23
20.0 N	0.15	0.15	0.15	0.18	0.18	0.14	0.13	0.13	0.15	0.14	0.15	0.15	0.18	0.24	0.24	0.24	0.24	0.25	0.24	0.22
17.5 N	0.15	0.16	0.17	0.18	0.22	0.18	0.13	0.14	0.16	0.18	0.21	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.22	0.21
15.0 N	0.17	0.19	0.20	0.17	0.20	0.19	0.19	0.20	0.21	0.22	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.21
12.5 N	0.20	0.20	0.21	0.16	0.17	0.19	0.19	0.20	0.21	0.22	0.23	0.23	0.24	0.24	0.23	0.23	0.23	0.23	0.22	0.20
10.0 N	0.21	0.20	0.19	0.15	0.16	0.18	0.17	0.18	0.20	0.22	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.22

October

	30.0 E	32.5 E	35.0 E	37.5 E	40.0 E	42.5 E	45.0 E	47.5 E	50.0 E	52.5 E	55.0 E	57.5 E	60.0 E	62.5 E	65.0 E	67.5 E	70.0 E	72.5 E	75.0 E	77.5 E
40.0 N	0.17	0.15	0.15	0.15	0.14	0.13	0.14	0.17	0.21	0.20	0.17	0.16	0.17	0.16	0.15	0.15				

ECM 1991 - 2000 Angle Error 5° Elevation (°)

Middle East

January

	30.0 E	32.5 E	35.0 E	37.5 E	40.0 E	42.5 E	45.0 E	47.5 E	50.0 E	52.5 E	55.0 E	57.5 E	60.0 E	62.5 E	65.0 E	67.5 E	70.0 E	72.5 E	75.0 E	77.5 E
40.0 N	0.11	0.10	0.10	0.11	0.10	0.09	0.09	0.11	0.13	0.13	0.12	0.12	0.13	0.12	0.12	0.11	0.09	0.07	0.07	0.09
37.5 N	0.11	0.11	0.11	0.11	0.11	0.10	0.10	0.11	0.12	0.11	0.10	0.10	0.11	0.12	0.12	0.11	0.08	0.06	0.06	0.08
35.0 N	0.13	0.13	0.13	0.12	0.12	0.13	0.11	0.09	0.10	0.11	0.10	0.10	0.10	0.10	0.09	0.08	0.08	0.07	0.07	0.05
32.5 N	0.14	0.14	0.13	0.11	0.11	0.12	0.12	0.12	0.10	0.09	0.10	0.11	0.10	0.11	0.09	0.08	0.10	0.13	0.11	0.07
30.0 N	0.13	0.12	0.11	0.11	0.11	0.11	0.12	0.13	0.12	0.09	0.09	0.09	0.10	0.11	0.11	0.10	0.11	0.12	0.12	0.11
27.5 N	0.12	0.12	0.12	0.11	0.10	0.11	0.11	0.12	0.13	0.12	0.11	0.11	0.10	0.10	0.10	0.10	0.11	0.11	0.11	0.12
25.0 N	0.11	0.12	0.13	0.12	0.11	0.11	0.11	0.11	0.12	0.14	0.13	0.13	0.13	0.12	0.12	0.12	0.11	0.11	0.11	0.11
22.5 N	0.11	0.11	0.12	0.14	0.12	0.10	0.11	0.11	0.11	0.12	0.12	0.12	0.14	0.15	0.14	0.14	0.12	0.11	0.11	0.11
20.0 N	0.11	0.11	0.12	0.14	0.14	0.11	0.10	0.12	0.12	0.12	0.13	0.14	0.14	0.14	0.14	0.14	0.14	0.12	0.11	0.11
17.5 N	0.11	0.11	0.12	0.13	0.15	0.12	0.10	0.11	0.11	0.12	0.14	0.15	0.15	0.15	0.15	0.15	0.15	0.14	0.11	0.11
15.0 N	0.10	0.11	0.11	0.11	0.13	0.13	0.11	0.12	0.13	0.14	0.15	0.15	0.16	0.15	0.15	0.15	0.15	0.13	0.13	0.12
12.5 N	0.10	0.11	0.11	0.10	0.11	0.13	0.13	0.14	0.15	0.15	0.16	0.16	0.16	0.15	0.16	0.16	0.16	0.16	0.14	0.13
10.0 N	0.10	0.11	0.11	0.09	0.10	0.12	0.12	0.13	0.14	0.15	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.15	0.14

April

	30.0 E	32.5 E	35.0 E	37.5 E	40.0 E	42.5 E	45.0 E	47.5 E	50.0 E	52.5 E	55.0 E	57.5 E	60.0 E	62.5 E	65.0 E	67.5 E	70.0 E	72.5 E	75.0 E	77.5 E
40.0 N	0.12	0.11	0.11	0.11	0.10	0.10	0.11	0.13	0.13	0.12	0.12	0.12	0.11	0.11	0.11	0.10	0.08	0.08	0.09	0.09
37.5 N	0.12	0.11	0.11	0.11	0.12	0.11	0.11	0.10	0.12	0.11	0.10	0.11	0.12	0.12	0.11	0.09	0.06	0.06	0.08	0.08
35.0 N	0.13	0.14	0.13	0.12	0.12	0.13	0.11	0.09	0.10	0.11	0.10	0.10	0.09	0.10	0.09	0.08	0.09	0.09	0.07	0.05
32.5 N	0.14	0.14	0.12	0.10	0.10	0.11	0.12	0.11	0.10	0.09	0.10	0.10	0.10	0.10	0.09	0.08	0.11	0.14	0.11	0.07
30.0 N	0.12	0.12	0.11	0.10	0.10	0.10	0.11	0.12	0.11	0.09	0.08	0.09	0.09	0.10	0.10	0.09	0.11	0.13	0.12	0.11
27.5 N	0.11	0.11	0.11	0.10	0.10	0.10	0.11	0.12	0.11	0.10	0.10	0.10	0.10	0.10	0.09	0.09	0.10	0.11	0.10	0.11
25.0 N	0.11	0.11	0.12	0.11	0.10	0.10	0.10	0.10	0.11	0.13	0.12	0.12	0.13	0.13	0.13	0.13	0.13	0.11	0.10	0.10
22.5 N	0.11	0.10	0.12	0.13	0.11	0.10	0.10	0.10	0.10	0.11	0.11	0.12	0.12	0.14	0.16	0.17	0.16	0.14	0.12	0.11
20.0 N	0.10	0.10	0.13	0.13	0.10	0.09	0.10	0.10	0.10	0.11	0.11	0.12	0.14	0.16	0.16	0.16	0.16	0.13	0.10	0.10
17.5 N	0.10	0.11	0.12	0.13	0.15	0.13	0.09	0.10	0.11	0.12	0.15	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.15	0.15
15.0 N	0.10	0.11	0.11	0.13	0.12	0.11	0.13	0.14	0.15	0.15	0.16	0.16	0.16	0.16	0.17	0.17	0.16	0.16	0.15	0.12
12.5 N	0.11	0.12	0.12	0.10	0.11	0.13	0.13	0.15	0.16	0.16	0.16	0.16	0.16	0.16	0.17	0.17	0.17	0.18	0.15	0.13
10.0 N	0.13	0.13	0.13	0.10	0.11	0.12	0.12	0.13	0.14	0.16	0.16	0.16	0.16	0.16	0.17	0.17	0.17	0.17	0.17	0.16

July

	30.0 E	32.5 E	35.0 E	37.5 E	40.0 E	42.5 E	45.0 E	47.5 E	50.0 E	52.5 E	55.0 E	57.5 E	60.0 E	62.5 E	65.0 E	67.5 E	70.0 E	72.5 E	75.0 E	77.5 E
40.0 N	0.12	0.11	0.12	0.12	0.11	0.10	0.10	0.11	0.14	0.14	0.11	0.11	0.11	0.11	0.10	0.10	0.09	0.07	0.08	0.10
37.5 N	0.11	0.11	0.12	0.11	0.11	0.10	0.10	0.13	0.14	0.11	0.09	0.11	0.11	0.11	0.10	0.08	0.07	0.07	0.09	0.09
35.0 N	0.15	0.16	0.15	0.13	0.12	0.12	0.10	0.09	0.09	0.10	0.10	0.09	0.09	0.09	0.09	0.08	0.08	0.09	0.09	0.07
32.5 N	0.16	0.17	0.15	0.12	0.11	0.11	0.11	0.10	0.09	0.08	0.09	0.09	0.09	0.10	0.09	0.09	0.09	0.12	0.15	0.08
30.0 N	0.14	0.14	0.12	0.11	0.10	0.10	0.10	0.11	0.11	0.08	0.08	0.08	0.09	0.10	0.10	0.10	0.13	0.15	0.15	0.14
27.5 N	0.12	0.12	0.12	0.10	0.10	0.09	0.11	0.12	0.11	0.10	0.10	0.10	0.10	0.10	0.10	0.12	0.14	0.14	0.16	0.16
25.0 N	0.11	0.11	0.12	0.12	0.10	0.10	0.10	0.09	0.11	0.13	0.13	0.13	0.14	0.15	0.15	0.16	0.16	0.15	0.15	0.15
22.5 N	0.11	0.10	0.12	0.13	0.11	0.09	0.09	0.10	0.10	0.11	0.11	0.12	0.16	0.18	0.18	0.17	0.17	0.16	0.16	0.15
20.0 N	0.11	0.10	0.13	0.13	0.10	0.09	0.10	0.10	0.10	0.11	0.12	0.15	0.17	0.17	0.17	0.17	0.17	0.17	0.15	0.15
17.5 N	0.11	0.11	0.12	0.13	0.15	0.13	0.09	0.10	0.11	0.12	0.15	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.15	0.15
15.0 N	0.12	0.13	0.13	0.11	0.13	0.10	0.11	0.12	0.12	0.15	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.15
12.5 N	0.14	0.14	0.14	0.11	0.12	0.13	0.13	0.14	0.15	0.15	0.16	0.17	0.16	0.16	0.16	0.16	0.16	0.17	0.16	0.14
10.0 N	0.15	0.15	0.13	0.11	0.11	0.12	0.12	0.12	0.14	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16

October

	30.0 E	32.5 E	35.0 E	37.5 E	40.0 E	42.5 E	45.0 E	47.5 E	50.0 E	52.5 E	55.0 E	57.5 E	60.0 E	62.5 E	65.0 E	67.5 E	70.0 E	72.5 E	75.0 E	77.5 E
40.0 N	0.12	0.10	0.11	0.10	0.09	0.10	0.12	0.14	0.14	0.12	0.11	0.12	0.11							

ECM 1991 - 2000 Angle Error 0° Elevation (°)

Amazon Rainforest

January

	82.5 W	80.0 W	77.5 W	75.0 W	72.5 W	70.0 W	67.5 W	65.0 W	62.5 W	60.0 W	57.5 W	55.0 W	52.5 W	50.0 W	47.5 W	45.0 W	42.5 W	40.0 W	37.5 W	35.0 W	
12.5 N	0.54	0.53	0.51	0.52	0.51	0.51	0.51	0.51	0.52	0.51	0.51	0.51	0.51	0.51	0.50	0.51	0.50	0.49	0.49	0.49	
10.0 N	0.52	0.51	0.54	0.50	0.44	0.44	0.46	0.48	0.51	0.53	0.52	0.50	0.50	0.52	0.51	0.50	0.51	0.50	0.50	0.50	
7.5 N	0.50	0.52	0.54	0.44	0.40	0.45	0.45	0.44	0.46	0.50	0.53	0.53	0.52	0.51	0.52	0.51	0.51	0.51	0.51	0.51	
5.0 N	0.52	0.55	0.49	0.38	0.41	0.51	0.48	0.42	0.42	0.47	0.50	0.51	0.54	0.52	0.52	0.52	0.52	0.51	0.51	0.52	
2.5 N	0.53	0.52	0.44	0.43	0.49	0.54	0.51	0.48	0.46	0.49	0.50	0.48	0.51	0.53	0.52	0.52	0.52	0.53	0.52	0.52	
0.0 N	0.54	0.45	0.40	0.50	0.53	0.52	0.52	0.53	0.53	0.51	0.51	0.50	0.51	0.54	0.53	0.53	0.52	0.52	0.52	0.52	
2.5 S	0.54	0.41	0.41	0.56	0.52	0.53	0.54	0.51	0.55	0.53	0.52	0.53	0.53	0.54	0.53	0.54	0.54	0.52	0.51	0.53	0.52
5.0 S	0.52	0.41	0.41	0.56	0.51	0.52	0.57	0.52	0.53	0.54	0.53	0.52	0.51	0.53	0.51	0.53	0.52	0.49	0.50	0.52	0.50
7.5 S	0.54	0.44	0.33	0.46	0.54	0.48	0.51	0.55	0.54	0.51	0.51	0.51	0.49	0.51	0.50	0.50	0.50	0.46	0.45	0.50	0.50
10.0 S	0.52	0.51	0.32	0.36	0.55	0.54	0.49	0.49	0.51	0.52	0.50	0.49	0.50	0.51	0.49	0.48	0.47	0.46	0.48	0.47	0.51
12.5 S	0.47	0.54	0.41	0.28	0.31	0.42	0.52	0.49	0.47	0.50	0.49	0.48	0.47	0.50	0.47	0.46	0.43	0.46	0.52	0.52	0.52
15.0 S	0.45	0.49	0.51	0.35	0.22	0.23	0.39	0.53	0.48	0.48	0.51	0.49	0.49	0.47	0.46	0.46	0.44	0.47	0.52	0.51	0.51
17.5 S	0.47	0.44	0.49	0.51	0.42	0.26	0.23	0.38	0.47	0.48	0.53	0.50	0.47	0.47	0.46	0.46	0.45	0.49	0.53	0.51	0.51

April

	82.5 W	80.0 W	77.5 W	75.0 W	72.5 W	70.0 W	67.5 W	65.0 W	62.5 W	60.0 W	57.5 W	55.0 W	52.5 W	50.0 W	47.5 W	45.0 W	42.5 W	40.0 W	37.5 W	35.0 W
12.5 N	0.54	0.54	0.53	0.54	0.52	0.52	0.52	0.52	0.52	0.51	0.51	0.52	0.51	0.50	0.51	0.50	0.49	0.49	0.49	0.49
10.0 N	0.53	0.52	0.55	0.53	0.47	0.47	0.47	0.47	0.50	0.54	0.53	0.51	0.51	0.52	0.51	0.50	0.51	0.51	0.50	0.50
7.5 N	0.51	0.52	0.55	0.45	0.43	0.50	0.49	0.45	0.45	0.50	0.53	0.54	0.53	0.51	0.53	0.52	0.51	0.52	0.51	0.51
5.0 N	0.52	0.56	0.49	0.38	0.42	0.54	0.51	0.44	0.43	0.47	0.51	0.52	0.55	0.52	0.52	0.53	0.52	0.53	0.52	0.53
2.5 N	0.54	0.53	0.44	0.43	0.50	0.54	0.51	0.49	0.48	0.51	0.52	0.49	0.54	0.53	0.54	0.53	0.53	0.53	0.53	0.53
0.0 N	0.55	0.45	0.40	0.50	0.52	0.51	0.52	0.53	0.54	0.51	0.53	0.52	0.52	0.55	0.54	0.54	0.53	0.53	0.53	0.52
2.5 S	0.54	0.42	0.41	0.55	0.51	0.53	0.54	0.50	0.55	0.54	0.53	0.54	0.54	0.54	0.54	0.55	0.53	0.52	0.54	0.53
5.0 S	0.53	0.42	0.40	0.55	0.51	0.52	0.57	0.52	0.53	0.54	0.54	0.54	0.52	0.51	0.53	0.52	0.53	0.51	0.52	0.53
7.5 S	0.55	0.45	0.33	0.46	0.53	0.47	0.51	0.55	0.54	0.51	0.52	0.51	0.50	0.52	0.51	0.51	0.50	0.47	0.48	0.52
10.0 S	0.54	0.52	0.32	0.35	0.55	0.54	0.49	0.49	0.52	0.52	0.50	0.50	0.51	0.51	0.49	0.48	0.46	0.47	0.50	0.53
12.5 S	0.48	0.56	0.41	0.27	0.30	0.42	0.52	0.50	0.47	0.50	0.50	0.48	0.52	0.51	0.47	0.45	0.43	0.47	0.53	0.53
15.0 S	0.46	0.51	0.52	0.35	0.21	0.22	0.39	0.52	0.48	0.47	0.50	0.49	0.49	0.47	0.45	0.45	0.43	0.48	0.53	0.51
17.5 S	0.47	0.44	0.49	0.52	0.42	0.25	0.21	0.37	0.46	0.46	0.51	0.49	0.46	0.47	0.45	0.44	0.44	0.49	0.53	0.51

July

	82.5 W	80.0 W	77.5 W	75.0 W	72.5 W	70.0 W	67.5 W	65.0 W	62.5 W	60.0 W	57.5 W	55.0 W	52.5 W	50.0 W	47.5 W	45.0 W	42.5 W	40.0 W	37.5 W	35.0 W
12.5 N	0.54	0.53	0.52	0.54	0.52	0.53	0.52	0.53	0.52	0.52	0.53	0.53	0.52	0.51	0.52	0.52	0.51	0.51	0.52	0.52
10.0 N	0.53	0.52	0.55	0.53	0.47	0.47	0.47	0.50	0.54	0.53	0.51	0.51	0.52	0.51	0.51	0.51	0.51	0.51	0.52	0.52
7.5 N	0.51	0.52	0.54	0.44	0.42	0.50	0.51	0.48	0.48	0.51	0.53	0.53	0.52	0.51	0.52	0.52	0.51	0.51	0.51	0.51
5.0 N	0.51	0.55	0.48	0.37	0.41	0.52	0.50	0.45	0.44	0.48	0.51	0.51	0.53	0.51	0.51	0.52	0.51	0.51	0.50	0.51
2.5 N	0.53	0.51	0.43	0.42	0.48	0.53	0.50	0.48	0.47	0.50	0.52	0.48	0.51	0.53	0.51	0.51	0.51	0.51	0.50	0.51
0.0 N	0.54	0.43	0.37	0.48	0.51	0.50	0.50	0.52	0.53	0.50	0.50	0.51	0.51	0.51	0.53	0.52	0.51	0.52	0.51	0.51
2.5 S	0.52	0.39	0.39	0.53	0.50	0.52	0.53	0.49	0.54	0.52	0.52	0.53	0.53	0.52	0.52	0.53	0.51	0.50	0.52	0.52
5.0 S	0.51	0.39	0.38	0.53	0.48	0.50	0.56	0.50	0.52	0.52	0.52	0.51	0.50	0.51	0.49	0.48	0.46	0.45	0.49	0.52
7.5 S	0.52	0.42	0.31	0.43	0.49	0.43	0.47	0.51	0.50	0.47	0.47	0.46	0.44	0.45	0.43	0.42	0.42	0.42	0.45	0.51
10.0 S	0.51	0.48	0.29	0.33	0.51	0.49	0.43	0.44	0.44	0.42	0.40	0.40	0.40	0.39	0.39	0.41	0.45	0.49	0.52	0.52
12.5 S	0.46	0.52	0.37	0.24	0.28	0.40	0.48	0.43	0.38	0.40	0.39	0.37	0.39	0.38	0.37	0.37	0.39	0.45	0.52	0.52
15.0 S	0.44	0.48	0.48	0.31	0.18	0.20	0.36	0.48	0.41	0.37	0.38	0.37	0.37	0.36	0.36	0.37	0.37	0.46	0.51	0.50
17.5 S	0.46	0.43	0.47	0.49	0.39	0.22	0.19	0.33	0.41	0.38	0.40	0.38	0.36	0.37	0.36	0.37	0.40	0.46	0.51	0.49

October

	82.5 W	80.0 W	77.5 W	75.0 W	72.5 W	70.0 W	67.5 W	65.0 W	62.5 W	60.0 W	57.5 W	55.0 W	52.5 W	50.0 W	47.5 W	45.0 W	42.5 W	40.0 W	37.5 W	35.0 W
12.5 N	0.54	0.53	0.52	0.54	0.53	0.53	0.52	0.52	0.52											

ECM 1991 - 2000 Angle Error 3° Elevation (°)
Amazon Rainforest
January

	82.5 W	80.0 W	77.5 W	75.0 W	72.5 W	70.0 W	67.5 W	65.0 W	62.5 W	60.0 W	57.5 W	55.0 W	52.5 W	50.0 W	47.5 W	45.0 W	42.5 W	40.0 W	37.5 W	35.0 W
12.5 N	0.24	0.24	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.22	0.22	0.22
10.0 N	0.24	0.23	0.24	0.23	0.20	0.20	0.21	0.22	0.23	0.24	0.24	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23
7.5 N	0.23	0.23	0.24	0.20	0.19	0.21	0.21	0.20	0.21	0.23	0.24	0.24	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23
5.0 N	0.23	0.25	0.22	0.18	0.19	0.23	0.22	0.20	0.19	0.21	0.22	0.23	0.23	0.24	0.23	0.24	0.23	0.23	0.23	0.23
2.5 N	0.24	0.23	0.20	0.20	0.22	0.24	0.23	0.22	0.21	0.22	0.23	0.22	0.23	0.24	0.23	0.24	0.24	0.24	0.23	0.24
0.0 N	0.24	0.21	0.19	0.23	0.24	0.23	0.23	0.24	0.24	0.23	0.23	0.23	0.23	0.24	0.24	0.24	0.24	0.24	0.24	0.23
2.5 S	0.24	0.19	0.19	0.25	0.23	0.24	0.24	0.23	0.25	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.23	0.24	0.24
5.0 S	0.24	0.19	0.19	0.25	0.23	0.24	0.26	0.24	0.24	0.24	0.24	0.24	0.23	0.24	0.24	0.23	0.23	0.22	0.23	0.23
7.5 S	0.24	0.20	0.16	0.21	0.24	0.22	0.23	0.25	0.24	0.23	0.23	0.23	0.22	0.23	0.23	0.23	0.23	0.21	0.21	0.23
10.0 S	0.23	0.23	0.16	0.17	0.24	0.24	0.22	0.22	0.23	0.23	0.23	0.23	0.22	0.23	0.23	0.22	0.22	0.21	0.21	0.23
12.5 S	0.21	0.24	0.19	0.14	0.15	0.19	0.23	0.22	0.21	0.23	0.22	0.22	0.23	0.23	0.22	0.21	0.21	0.20	0.21	0.24
15.0 S	0.21	0.22	0.23	0.17	0.12	0.12	0.18	0.23	0.22	0.22	0.23	0.22	0.22	0.22	0.21	0.21	0.21	0.21	0.21	0.23
17.5 S	0.21	0.20	0.22	0.23	0.19	0.13	0.12	0.18	0.21	0.22	0.24	0.23	0.22	0.22	0.21	0.21	0.21	0.22	0.24	0.23

April

	82.5 W	80.0 W	77.5 W	75.0 W	72.5 W	70.0 W	67.5 W	65.0 W	62.5 W	60.0 W	57.5 W	55.0 W	52.5 W	50.0 W	47.5 W	45.0 W	42.5 W	40.0 W	37.5 W	35.0 W
12.5 N	0.24	0.24	0.24	0.24	0.23	0.23	0.23	0.24	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.22	0.22	0.22
10.0 N	0.24	0.24	0.25	0.24	0.21	0.21	0.21	0.21	0.23	0.24	0.24	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23
7.5 N	0.23	0.24	0.24	0.21	0.20	0.23	0.22	0.21	0.21	0.23	0.24	0.24	0.23	0.23	0.24	0.23	0.23	0.23	0.23	0.23
5.0 N	0.24	0.25	0.22	0.18	0.20	0.24	0.23	0.20	0.20	0.22	0.23	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24
2.5 N	0.24	0.24	0.20	0.20	0.22	0.24	0.23	0.22	0.22	0.23	0.24	0.23	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24
0.0 N	0.24	0.21	0.19	0.23	0.24	0.23	0.23	0.24	0.24	0.23	0.24	0.24	0.24	0.25	0.24	0.24	0.24	0.24	0.24	0.24
2.5 S	0.24	0.19	0.19	0.25	0.23	0.24	0.24	0.23	0.25	0.24	0.24	0.24	0.24	0.24	0.24	0.25	0.24	0.24	0.24	0.24
5.0 S	0.24	0.19	0.19	0.25	0.23	0.23	0.26	0.24	0.24	0.24	0.24	0.24	0.23	0.24	0.24	0.23	0.24	0.23	0.24	0.24
7.5 S	0.25	0.21	0.16	0.21	0.24	0.22	0.23	0.25	0.24	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.22	0.22	0.23
10.0 S	0.24	0.23	0.16	0.17	0.24	0.24	0.22	0.23	0.23	0.24	0.23	0.23	0.23	0.23	0.22	0.22	0.21	0.21	0.23	0.24
12.5 S	0.22	0.25	0.19	0.14	0.15	0.19	0.23	0.23	0.21	0.23	0.23	0.22	0.23	0.23	0.23	0.22	0.21	0.20	0.22	0.24
15.0 S	0.21	0.23	0.23	0.17	0.11	0.12	0.18	0.23	0.22	0.22	0.23	0.22	0.22	0.21	0.21	0.20	0.20	0.22	0.24	0.23
17.5 S	0.22	0.20	0.22	0.23	0.19	0.12	0.11	0.17	0.21	0.21	0.23	0.22	0.21	0.21	0.20	0.20	0.22	0.24	0.23	0.23

July

	82.5 W	80.0 W	77.5 W	75.0 W	72.5 W	70.0 W	67.5 W	65.0 W	62.5 W	60.0 W	57.5 W	55.0 W	52.5 W	50.0 W	47.5 W	45.0 W	42.5 W	40.0 W	37.5 W	35.0 W
12.5 N	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.23	0.23	0.23
10.0 N	0.24	0.23	0.25	0.24	0.22	0.22	0.23	0.23	0.24	0.24	0.24	0.23	0.24	0.24	0.24	0.24	0.24	0.23	0.23	0.24
7.5 N	0.23	0.24	0.24	0.20	0.20	0.23	0.23	0.22	0.22	0.23	0.24	0.24	0.24	0.23	0.24	0.23	0.23	0.23	0.23	0.23
5.0 N	0.23	0.25	0.22	0.18	0.19	0.24	0.23	0.21	0.20	0.22	0.23	0.23	0.24	0.23	0.23	0.23	0.23	0.23	0.23	0.23
2.5 N	0.24	0.23	0.20	0.19	0.22	0.24	0.23	0.22	0.22	0.23	0.23	0.22	0.23	0.24	0.23	0.23	0.23	0.23	0.23	0.23
0.0 N	0.24	0.20	0.18	0.22	0.23	0.23	0.23	0.23	0.24	0.23	0.23	0.23	0.23	0.24	0.24	0.23	0.23	0.23	0.23	0.23
2.5 S	0.23	0.18	0.18	0.24	0.22	0.23	0.24	0.22	0.24	0.24	0.23	0.24	0.24	0.24	0.24	0.24	0.23	0.23	0.23	0.23
5.0 S	0.23	0.18	0.18	0.24	0.22	0.23	0.25	0.23	0.23	0.24	0.24	0.23	0.23	0.24	0.23	0.22	0.22	0.21	0.22	0.24
7.5 S	0.23	0.19	0.15	0.20	0.22	0.20	0.22	0.23	0.23	0.21	0.21	0.21	0.20	0.21	0.20	0.19	0.19	0.19	0.19	0.21
10.0 S	0.23	0.22	0.14	0.16	0.23	0.22	0.20	0.20	0.20	0.20	0.19	0.19	0.19	0.19	0.18	0.18	0.18	0.19	0.20	0.23
12.5 S	0.21	0.23	0.17	0.13	0.14	0.18	0.22	0.20	0.18	0.19	0.19	0.18	0.18	0.18	0.17	0.17	0.17	0.17	0.18	0.23
15.0 S	0.20	0.22	0.15	0.10	0.11	0.17	0.21	0.20	0.19	0.19	0.18	0.18	0.18	0.17	0.17	0.17	0.17	0.17	0.18	0.23
17.5 S	0.21	0.20	0.21	0.22	0.18	0.12	0.11	0.17	0.20	0.19	0.18	0.18	0.17	0.17	0.17	0.17	0.17	0.17	0.18	0.23

October

	82.5 W	80.0 W	77.5 W	75.0 W	72.5 W	70.0 W	67.5 W	65.0 W	62.5 W	60.0 W	57.5 W	55.0 W	52.5 W	50.0 W	47.5 W	45.0 W	42.5 W	40.0 W	37.5 W	35.0 W
12.5 N	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.23	0.23	0.24
10.0 N																				

ECM 1991 - 2000 Angle Error 0° Elevation (°)

North East Asia

January

	105.0 E	107.5 E	110.0 E	112.5 E	115.0 E	117.5 E	120.0 E	122.5 E	125.0 E	127.5 E	130.0 E	132.5 E	135.0 E	137.5 E	140.0 E	142.5 E	145.0 E	147.5 E	150.0 E
55.0 N	0.37	0.34	0.32	0.31	0.32	0.33	0.33	0.34	0.36	0.36	0.35	0.34	0.35	0.38	0.39	0.40	0.38	0.38	0.38
52.5 N	0.36	0.35	0.32	0.32	0.34	0.35	0.34	0.35	0.37	0.38	0.37	0.36	0.36	0.37	0.39	0.39	0.39	0.38	0.38
50.0 N	0.32	0.32	0.30	0.32	0.35	0.35	0.34	0.35	0.37	0.38	0.37	0.37	0.36	0.36	0.37	0.38	0.39	0.39	0.39
47.5 N	0.31	0.30	0.30	0.32	0.35	0.34	0.34	0.36	0.38	0.38	0.37	0.38	0.38	0.37	0.37	0.38	0.38	0.38	0.38
45.0 N	0.30	0.31	0.33	0.33	0.32	0.32	0.34	0.38	0.39	0.37	0.36	0.37	0.37	0.37	0.37	0.38	0.38	0.38	0.39
42.5 N	0.30	0.30	0.32	0.31	0.29	0.31	0.34	0.37	0.36	0.34	0.34	0.37	0.38	0.38	0.38	0.37	0.37	0.38	0.39
40.0 N	0.30	0.29	0.29	0.30	0.32	0.35	0.37	0.38	0.36	0.35	0.36	0.40	0.40	0.39	0.38	0.38	0.39	0.39	0.39
37.5 N	0.28	0.29	0.29	0.31	0.35	0.38	0.38	0.38	0.38	0.37	0.38	0.40	0.39	0.36	0.36	0.39	0.40	0.40	0.4
35.0 N	0.25	0.29	0.31	0.34	0.37	0.37	0.38	0.38	0.38	0.37	0.37	0.38	0.38	0.36	0.37	0.40	0.41	0.41	0.41
32.5 N	0.29	0.31	0.31	0.35	0.38	0.37	0.39	0.40	0.40	0.40	0.39	0.40	0.40	0.41	0.42	0.42	0.42	0.42	0.42
30.0 N	0.37	0.35	0.33	0.38	0.39	0.36	0.38	0.40	0.41	0.42	0.42	0.41	0.42	0.42	0.43	0.43	0.43	0.43	0.43
27.5 N	0.32	0.34	0.36	0.39	0.38	0.36	0.39	0.43	0.43	0.43	0.43	0.44	0.43	0.43	0.44	0.44	0.44	0.44	0.44

April

	105.0 E	107.5 E	110.0 E	112.5 E	115.0 E	117.5 E	120.0 E	122.5 E	125.0 E	127.5 E	130.0 E	132.5 E	135.0 E	137.5 E	140.0 E	142.5 E	145.0 E	147.5 E	150.0 E
55.0 N	0.36	0.33	0.30	0.29	0.30	0.31	0.32	0.32	0.34	0.34	0.33	0.32	0.34	0.36	0.39	0.39	0.38	0.38	0.39
52.5 N	0.35	0.35	0.31	0.31	0.33	0.33	0.33	0.33	0.36	0.37	0.36	0.34	0.34	0.36	0.38	0.38	0.38	0.38	0.39
50.0 N	0.32	0.31	0.29	0.30	0.33	0.33	0.32	0.33	0.35	0.36	0.36	0.35	0.35	0.36	0.38	0.39	0.39	0.39	0.39
47.5 N	0.30	0.29	0.28	0.30	0.33	0.32	0.32	0.34	0.37	0.36	0.36	0.37	0.37	0.36	0.37	0.38	0.39	0.38	0.38
45.0 N	0.28	0.29	0.30	0.31	0.30	0.30	0.33	0.37	0.39	0.36	0.35	0.37	0.37	0.37	0.38	0.39	0.38	0.38	0.39
42.5 N	0.27	0.28	0.30	0.29	0.28	0.29	0.33	0.37	0.36	0.33	0.34	0.37	0.37	0.38	0.38	0.39	0.38	0.37	0.39
40.0 N	0.27	0.26	0.27	0.28	0.30	0.34	0.36	0.38	0.37	0.37	0.35	0.37	0.41	0.39	0.39	0.39	0.40	0.4	0.4
37.5 N	0.27	0.27	0.27	0.30	0.34	0.36	0.37	0.39	0.40	0.39	0.39	0.41	0.39	0.37	0.38	0.41	0.41	0.41	0.41
35.0 N	0.26	0.29	0.31	0.35	0.38	0.38	0.39	0.40	0.40	0.40	0.39	0.40	0.39	0.39	0.40	0.43	0.42	0.42	0.42
32.5 N	0.32	0.33	0.33	0.39	0.42	0.41	0.42	0.42	0.41	0.42	0.42	0.42	0.42	0.42	0.43	0.44	0.44	0.44	0.44
30.0 N	0.41	0.38	0.36	0.43	0.45	0.42	0.42	0.43	0.43	0.44	0.44	0.45	0.44	0.45	0.45	0.45	0.45	0.46	0.45
27.5 N	0.35	0.38	0.41	0.45	0.44	0.42	0.44	0.46	0.46	0.46	0.46	0.46	0.47	0.46	0.47	0.47	0.47	0.48	0.48

July

	105.0 E	107.5 E	110.0 E	112.5 E	115.0 E	117.5 E	120.0 E	122.5 E	125.0 E	127.5 E	130.0 E	132.5 E	135.0 E	137.5 E	140.0 E	142.5 E	145.0 E	147.5 E	150.0 E
55.0 N	0.41	0.37	0.34	0.33	0.35	0.37	0.37	0.38	0.40	0.40	0.39	0.38	0.39	0.41	0.43	0.42	0.41	0.40	0.41
52.5 N	0.41	0.40	0.36	0.35	0.38	0.39	0.38	0.39	0.43	0.45	0.43	0.41	0.40	0.41	0.42	0.42	0.41	0.41	0.42
50.0 N	0.37	0.36	0.32	0.33	0.37	0.37	0.36	0.38	0.42	0.44	0.44	0.43	0.42	0.41	0.41	0.42	0.42	0.42	0.41
47.5 N	0.32	0.30	0.29	0.32	0.35	0.35	0.36	0.41	0.45	0.44	0.44	0.46	0.45	0.43	0.42	0.43	0.43	0.42	0.41
45.0 N	0.28	0.29	0.31	0.33	0.32	0.33	0.38	0.46	0.48	0.44	0.43	0.44	0.44	0.43	0.44	0.44	0.43	0.42	0.43
42.5 N	0.27	0.29	0.31	0.31	0.34	0.41	0.46	0.46	0.45	0.41	0.41	0.44	0.46	0.46	0.46	0.44	0.43	0.44	0.45
40.0 N	0.29	0.29	0.30	0.33	0.38	0.43	0.46	0.48	0.47	0.45	0.46	0.49	0.50	0.48	0.47	0.47	0.47	0.47	0.47
37.5 N	0.30	0.32	0.34	0.40	0.47	0.49	0.48	0.50	0.51	0.49	0.49	0.50	0.48	0.46	0.48	0.50	0.50	0.49	0.49
35.0 N	0.30	0.36	0.41	0.47	0.51	0.50	0.51	0.51	0.50	0.49	0.49	0.49	0.48	0.48	0.51	0.52	0.52	0.51	0.51
32.5 N	0.38	0.41	0.42	0.50	0.54	0.53	0.54	0.54	0.53	0.53	0.53	0.52	0.52	0.53	0.54	0.53	0.53	0.53	0.53
30.0 N	0.49	0.47	0.45	0.52	0.54	0.50	0.52	0.54	0.54	0.55	0.54	0.54	0.54	0.54	0.54	0.53	0.53	0.53	0.53
27.5 N	0.42	0.44	0.48	0.52	0.51	0.49	0.52	0.55	0.55	0.54	0.54	0.54	0.54	0.53	0.53	0.54	0.54	0.54	0.54

October

	105.0 E	107.5 E	110.0 E	112.5 E	115.0 E	117.5 E	120.0 E	122.5 E	125.0 E	127.5 E	130.0 E	132.5 E	135.0 E	137.5 E	140.0 E	142.5 E	145.0 E	147.5 E	150.0 E
55.0 N	0.36	0.34	0.30	0.30	0.31	0.32	0.33	0.34	0.34	0.33	0.32	0.34	0.37	0.39	0.39	0.39	0.38	0.39	0.39
52.5 N	0.35	0.35	0.31	0.31	0.34	0.34	0.33	0.36	0.37	0.36	0.34	0.34	0.36	0.38	0.39	0.39	0.39	0.39	0.4
50.0 N	0.32	0.31	0.29	0.30	0.33	0.33	0.31	0.32	0.35	0.36	0.36	0.35	0.35	0.37	0.39	0.40	0.40	0.40	0.4
47.5 N	0.30	0.28	0.27	0.30	0.33	0.32	0.32	0.34	0.37	0.38	0.36	0.37	0.38	0.38	0.40	0.40	0.40	0.40	0.4
45.0 N	0.27	0.28	0.30	0.31	0.30	0.30	0.32	0.37	0.38	0.36	0.36	0.37	0.38	0.40	0.40	0.40	0.40	0.40	0.41
42.5 N	0.27	0.28	0.30	0.29	0.28	0.29	0.33</td												

ECM 1991 - 2000 Angle Error 3° Elevation (°)

North East Asia

January

	105.0 E	107.5 E	110.0 E	112.5 E	115.0 E	117.5 E	120.0 E	122.5 E	125.0 E	127.5 E	130.0 E	132.5 E	135.0 E	137.5 E	140.0 E	142.5 E	145.0 E	147.5 E	150.0 E
55.0 N	0.17	0.16	0.15	0.15	0.15	0.16	0.16	0.16	0.17	0.17	0.16	0.16	0.17	0.18	0.18	0.18	0.18	0.18	0.18
52.5 N	0.17	0.16	0.16	0.15	0.16	0.16	0.16	0.17	0.17	0.18	0.17	0.17	0.17	0.17	0.18	0.18	0.18	0.18	0.18
50.0 N	0.15	0.15	0.15	0.15	0.16	0.16	0.16	0.16	0.17	0.18	0.17	0.17	0.17	0.17	0.18	0.18	0.18	0.18	0.18
47.5 N	0.15	0.14	0.15	0.15	0.16	0.16	0.16	0.17	0.18	0.18	0.18	0.18	0.18	0.17	0.17	0.18	0.18	0.18	0.18
45.0 N	0.14	0.15	0.15	0.16	0.15	0.15	0.16	0.18	0.18	0.18	0.17	0.17	0.17	0.17	0.18	0.18	0.18	0.18	0.18
42.5 N	0.14	0.15	0.15	0.14	0.15	0.16	0.17	0.17	0.17	0.16	0.16	0.17	0.18	0.18	0.18	0.18	0.17	0.18	0.18
40.0 N	0.14	0.14	0.14	0.15	0.17	0.17	0.17	0.18	0.18	0.17	0.16	0.17	0.18	0.19	0.18	0.18	0.18	0.18	0.18
37.5 N	0.13	0.14	0.14	0.15	0.17	0.18	0.18	0.18	0.18	0.17	0.18	0.18	0.18	0.17	0.17	0.18	0.18	0.18	0.18
35.0 N	0.12	0.14	0.15	0.16	0.17	0.17	0.18	0.18	0.18	0.18	0.18	0.17	0.18	0.17	0.18	0.19	0.19	0.19	0.19
32.5 N	0.14	0.15	0.15	0.17	0.18	0.18	0.19	0.19	0.19	0.19	0.18	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.2
30.0 N	0.17	0.16	0.16	0.18	0.18	0.17	0.18	0.19	0.19	0.19	0.19	0.19	0.19	0.20	0.20	0.20	0.20	0.20	0.2
27.5 N	0.15	0.16	0.17	0.18	0.18	0.17	0.18	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20

April

	105.0 E	107.5 E	110.0 E	112.5 E	115.0 E	117.5 E	120.0 E	122.5 E	125.0 E	127.5 E	130.0 E	132.5 E	135.0 E	137.5 E	140.0 E	142.5 E	145.0 E	147.5 E	150.0 E
55.0 N	0.17	0.16	0.15	0.14	0.15	0.15	0.15	0.15	0.16	0.16	0.16	0.16	0.17	0.18	0.18	0.18	0.18	0.18	0.18
52.5 N	0.16	0.16	0.15	0.15	0.16	0.16	0.16	0.16	0.17	0.17	0.17	0.16	0.17	0.18	0.18	0.18	0.18	0.18	0.18
50.0 N	0.15	0.15	0.14	0.15	0.16	0.16	0.15	0.16	0.17	0.17	0.17	0.17	0.17	0.17	0.18	0.18	0.18	0.18	0.18
47.5 N	0.14	0.14	0.14	0.15	0.15	0.15	0.15	0.16	0.16	0.17	0.17	0.17	0.17	0.17	0.17	0.18	0.18	0.18	0.18
45.0 N	0.13	0.14	0.14	0.15	0.14	0.14	0.16	0.17	0.17	0.18	0.18	0.18	0.19	0.19	0.19	0.19	0.19	0.19	0.19
42.5 N	0.13	0.13	0.14	0.14	0.14	0.14	0.16	0.16	0.17	0.17	0.16	0.16	0.17	0.18	0.18	0.18	0.18	0.18	0.18
40.0 N	0.13	0.13	0.13	0.14	0.15	0.16	0.17	0.17	0.18	0.18	0.17	0.17	0.19	0.19	0.19	0.19	0.19	0.19	0.19
37.5 N	0.13	0.13	0.13	0.15	0.16	0.17	0.17	0.18	0.18	0.18	0.18	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19
35.0 N	0.13	0.14	0.15	0.17	0.18	0.18	0.18	0.19	0.19	0.19	0.19	0.19	0.18	0.18	0.18	0.19	0.20	0.20	0.2
32.5 N	0.15	0.16	0.16	0.18	0.19	0.19	0.19	0.20	0.20	0.20	0.20	0.20	0.21	0.21	0.21	0.21	0.21	0.21	0.21
30.0 N	0.18	0.18	0.17	0.20	0.21	0.19	0.19	0.20	0.20	0.20	0.20	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21
27.5 N	0.16	0.18	0.19	0.21	0.20	0.20	0.20	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.22	0.22	0.22	0.22

July

	105.0 E	107.5 E	110.0 E	112.5 E	115.0 E	117.5 E	120.0 E	122.5 E	125.0 E	127.5 E	130.0 E	132.5 E	135.0 E	137.5 E	140.0 E	142.5 E	145.0 E	147.5 E	150.0 E
55.0 N	0.19	0.18	0.16	0.16	0.17	0.17	0.17	0.18	0.19	0.19	0.18	0.18	0.19	0.20	0.19	0.19	0.19	0.19	0.19
52.5 N	0.19	0.19	0.17	0.17	0.18	0.18	0.18	0.18	0.20	0.20	0.20	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19
50.0 N	0.17	0.17	0.15	0.16	0.17	0.17	0.17	0.18	0.19	0.20	0.20	0.20	0.20	0.19	0.19	0.20	0.19	0.19	0.19
47.5 N	0.15	0.15	0.14	0.15	0.16	0.16	0.17	0.19	0.20	0.21	0.21	0.21	0.21	0.20	0.20	0.20	0.19	0.19	0.19
45.0 N	0.14	0.14	0.15	0.15	0.16	0.16	0.18	0.21	0.22	0.22	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.2
42.5 N	0.13	0.14	0.15	0.15	0.16	0.16	0.19	0.21	0.21	0.19	0.19	0.20	0.21	0.21	0.21	0.20	0.20	0.20	0.21
40.0 N	0.14	0.14	0.15	0.16	0.18	0.20	0.21	0.22	0.22	0.21	0.21	0.22	0.23	0.22	0.22	0.22	0.21	0.22	0.22
37.5 N	0.14	0.15	0.16	0.19	0.21	0.22	0.22	0.23	0.23	0.23	0.22	0.23	0.22	0.22	0.21	0.22	0.23	0.23	0.22
35.0 N	0.15	0.17	0.19	0.21	0.23	0.23	0.23	0.23	0.23	0.23	0.22	0.22	0.22	0.22	0.23	0.24	0.24	0.23	0.23
32.5 N	0.18	0.19	0.20	0.23	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.23	0.24	0.24	0.24	0.24	0.24
30.0 N	0.22	0.21	0.21	0.24	0.24	0.23	0.24	0.24	0.24	0.25	0.25	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24
27.5 N	0.19	0.20	0.22	0.24	0.23	0.22	0.23	0.25	0.25	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24

October

	105.0 E	107.5 E	110.0 E	112.5 E	115.0 E	117.5 E	120.0 E	122.5 E	125.0 E	127.5 E	130.0 E	132.5 E	135.0 E	137.5 E	140.0 E	142.5 E	145.0 E	147.5 E	150.0 E
55.0 N	0.17	0.16	0.15	0.14	0.15	0.15	0.15	0.16	0.16	0.16	0.16	0.16	0.17	0.17	0.18	0.18	0.18	0.18	0.18
52.5 N	0.16	0.16	0.15	0.15	0.16	0.16	0.16	0.16	0.17	0.17	0.16	0.16	0.17	0.18	0.18	0.18	0.18	0.18	0.19
50.0 N	0.15	0.15	0.14	0.14	0.16	0.16	0.15	0.15	0.17	0.17	0.17	0.17	0.17	0.17	0.18	0.18	0.19	0.19	0.19
47.5 N	0.14	0.14	0.14	0.14	0.15	0.15	0.15	0.16	0.17	0.17	0.17	0.17	0.18	0.18	0.18	0.18	0.19	0.19	0.19
45.0 N	0.13	0.14	0.14	0.15	0.14	0.14	0.15	0.17	0.18	0.17	0.17	0.18	0.18	0.18	0.18	0.19	0.19	0.19	0.19
42.5 N	0.13	0.14	0.14	0.14	0.14	0.14	0.16</td												

ECM 1991 - 2000 Angle Error 5° Elevation (°)

North East Asia

January

Apri

Jul

October

ECM 1991 - 2000 Angle Error 0° Elevation (°)

South East Asia

January

	90.0 E	92.5 E	95.0 E	97.5 E	100.0 E	102.5 E	105.0 E	107.5 E	110.0 E	112.5 E	115.0 E	117.5 E	120.0 E	122.5 E	125.0 E	127.5 E	130.0 E	132.5 E	135.0 E	137.5 E	140.0 E	142.5 E	145.0 E	147.5 E	150.0 E	
25.0 N	0.41	0.37	0.37	0.34	0.27	0.27	0.31	0.35	0.39	0.37	0.37	0.40	0.42	0.45	0.46	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.46	
22.5 N	0.41	0.35	0.31	0.32	0.32	0.34	0.38	0.42	0.42	0.40	0.44	0.46	0.46	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.48	0.48	0.48	
20.0 N	0.44	0.42	0.38	0.35	0.35	0.37	0.42	0.46	0.46	0.46	0.50	0.50	0.49	0.50	0.50	0.49	0.49	0.49	0.49	0.49	0.49	0.5	0.5	0.5	0.5	
17.5 N	0.44	0.46	0.43	0.39	0.39	0.41	0.45	0.48	0.50	0.50	0.50	0.50	0.49	0.50	0.51	0.51	0.51	0.51	0.51	0.51	0.52	0.52	0.52	0.52	0.52	
15.0 N	0.47	0.47	0.46	0.44	0.43	0.44	0.44	0.45	0.49	0.52	0.52	0.52	0.50	0.50	0.52	0.52	0.53	0.52	0.53	0.53	0.53	0.53	0.53	0.53	0.54	
12.5 N	0.50	0.49	0.50	0.48	0.46	0.46	0.44	0.44	0.49	0.52	0.52	0.52	0.52	0.52	0.53	0.53	0.53	0.54	0.54	0.54	0.54	0.54	0.53	0.53	0.53	
10.0 N	0.51	0.50	0.51	0.50	0.49	0.49	0.48	0.49	0.52	0.53	0.52	0.52	0.52	0.51	0.51	0.53	0.54	0.53	0.54	0.53	0.53	0.54	0.54	0.54	0.54	
7.5 N	0.52	0.53	0.52	0.51	0.52	0.50	0.50	0.52	0.52	0.54	0.53	0.52	0.53	0.51	0.50	0.53	0.54	0.53	0.54	0.53	0.53	0.52	0.53	0.54	0.54	
5.0 N	0.52	0.53	0.51	0.50	0.50	0.50	0.52	0.52	0.54	0.54	0.50	0.51	0.53	0.52	0.52	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.52	0.52	
2.5 N	0.52	0.52	0.51	0.50	0.50	0.52	0.53	0.52	0.54	0.51	0.46	0.51	0.53	0.52	0.52	0.52	0.53	0.52	0.52	0.52	0.52	0.52	0.52	0.53	0.53	
0.0 N	0.51	0.52	0.52	0.52	0.52	0.52	0.54	0.52	0.53	0.49	0.48	0.53	0.50	0.49	0.52	0.51	0.52	0.52	0.52	0.53	0.54	0.53	0.52	0.52	0.52	
2.5 S	0.52	0.52	0.51	0.52	0.51	0.51	0.54	0.53	0.53	0.53	0.54	0.53	0.48	0.50	0.53	0.51	0.52	0.52	0.5	0.49	0.5	0.52	0.53	0.54	0.52	0.52
5.0 S	0.52	0.52	0.52	0.52	0.51	0.53	0.53	0.52	0.52	0.53	0.54	0.52	0.51	0.53	0.52	0.53	0.53	0.51	0.48	0.47	0.45	0.46	0.51	0.53	0.53	0.52
7.5 S	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.51	0.51	0.51	0.52	0.52	0.52	0.52	0.53	0.53	0.54	0.54	0.5	0.45	0.47	0.52	0.52	0.52	
10.0 S	0.52	0.53	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.51	0.51	0.52	0.52	0.53	0.53	0.54	0.54	0.54	0.56	0.53	0.51	0.52	0.52	
12.5 S	0.52	0.52	0.53	0.53	0.52	0.52	0.52	0.52	0.52	0.53	0.53	0.53	0.53	0.54	0.54	0.54	0.55	0.54	0.54	0.53	0.51	0.53	0.53	0.53	0.53	

April

	90.0 E	92.5 E	95.0 E	97.5 E	100.0 E	102.5 E	105.0 E	107.5 E	110.0 E	112.5 E	115.0 E	117.5 E	120.0 E	122.5 E	125.0 E	127.5 E	130.0 E	132.5 E	135.0 E	137.5 E	140.0 E	142.5 E	145.0 E	147.5 E	150.0 E
25.0 N	0.43	0.40	0.41	0.36	0.27	0.27	0.33	0.40	0.46	0.45	0.45	0.46	0.46	0.46	0.48	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.5
22.5 N	0.46	0.39	0.34	0.33	0.33	0.35	0.42	0.48	0.49	0.47	0.50	0.51	0.48	0.50	0.51	0.51	0.52	0.51	0.51	0.51	0.52	0.52	0.52	0.52	0.52
20.0 N	0.55	0.49	0.40	0.37	0.38	0.42	0.46	0.51	0.52	0.52	0.54	0.53	0.52	0.53	0.53	0.53	0.53	0.52	0.53	0.53	0.52	0.53	0.52	0.53	0.52
17.5 N	0.55	0.54	0.47	0.43	0.45	0.49	0.50	0.52	0.54	0.55	0.54	0.53	0.51	0.52	0.53	0.54	0.54	0.54	0.54	0.53	0.53	0.53	0.53	0.53	0.53
15.0 N	0.53	0.54	0.52	0.49	0.50	0.53	0.52	0.49	0.52	0.55	0.54	0.54	0.54	0.52	0.51	0.54	0.53	0.54	0.54	0.53	0.54	0.53	0.54	0.54	0.54
12.5 N	0.55	0.54	0.55	0.54	0.52	0.53	0.52	0.48	0.51	0.55	0.53	0.54	0.54	0.53	0.53	0.55	0.54	0.54	0.54	0.54	0.54	0.54	0.53	0.53	0.53
10.0 N	0.54	0.53	0.54	0.53	0.53	0.53	0.53	0.53	0.54	0.55	0.54	0.53	0.53	0.52	0.51	0.53	0.55	0.54	0.54	0.53	0.54	0.54	0.54	0.54	0.54
7.5 N	0.53	0.54	0.53	0.52	0.54	0.53	0.53	0.54	0.53	0.54	0.54	0.53	0.54	0.52	0.51	0.54	0.53	0.54	0.54	0.53	0.53	0.54	0.53	0.53	0.54
5.0 N	0.52	0.52	0.51	0.51	0.52	0.53	0.54	0.53	0.54	0.55	0.51	0.51	0.54	0.53	0.53	0.54	0.53	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.53
2.5 N	0.52	0.52	0.51	0.51	0.51	0.53	0.54	0.52	0.54	0.52	0.47	0.51	0.54	0.52	0.53	0.53	0.53	0.53	0.53	0.53	0.52	0.52	0.53	0.53	0.53
0.0 N	0.51	0.52	0.52	0.52	0.53	0.53	0.55	0.52	0.53	0.50	0.49	0.54	0.51	0.50	0.52	0.52	0.52	0.52	0.52	0.52	0.54	0.54	0.54	0.53	0.53
2.5 S	0.52	0.52	0.52	0.51	0.52	0.54	0.54	0.54	0.54	0.55	0.54	0.54	0.54	0.50	0.53	0.52	0.52	0.53	0.51	0.5	0.5	0.53	0.54	0.54	0.53
5.0 S	0.53	0.53	0.52	0.53	0.52	0.52	0.53	0.52	0.52	0.54	0.54	0.53	0.52	0.53	0.53	0.54	0.52	0.53	0.54	0.52	0.49	0.48	0.46	0.47	0.52
7.5 S	0.52	0.53	0.53	0.53	0.53	0.53	0.53	0.52	0.52	0.52	0.52	0.53	0.52	0.52	0.53	0.53	0.54	0.55	0.55	0.52	0.46	0.48	0.52	0.52	0.52
10.0 S	0.53	0.54	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.52	0.52	0.53	0.52	0.52	0.52	0.52	0.52	0.53	0.53	0.54	0.56	0.54	0.52	0.52	0.52
12.5 S	0.53	0.53	0.53	0.54	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.52	0.52	0.52	0.52	0.51	0.53	0.52	0.5	0.52	0.54	0.54	0.53

July

	90.0 E	92.5 E	95.0 E	97.5 E	100.0 E	102.5 E	105.0 E	107.5 E	110.0 E	112.5 E	115.0 E	117.5 E	120.0 E	122.5 E	125.0 E	127.5 E	130.0 E	132.5 E	135.0 E	137.5 E	140.0 E	142.5 E	145.0 E	147.5 E	150.0 E	
25.0 N	0.55	0.50	0.50	0.43	0.35	0.35	0.39	0.45	0.50	0.50	0.50	0.52	0.52	0.53	0.55	0.54	0.54	0.54	0.54	0.54	0.54	0.53	0.53	0.53	0.53	
22.5 N	0.56	0.50	0.46	0.44	0.41	0.42	0.47	0.53	0.55	0.52	0.55	0.55	0.52	0.53	0.54	0.54	0.55	0.54	0.54	0.54	0.54	0.53	0.53	0.53	0.53	
20.0 N	0.55	0.53	0.52	0.47	0.43	0.45	0.50	0.54	0.55	0.54	0.56	0.55	0.53	0.55	0.54	0.54	0.54	0.53	0.54	0.54	0.53	0.53	0.53	0.53	0.53	
17.5 N	0.53	0.54	0.54	0.51	0.49	0.50	0.51	0.52	0.53	0.55	0.54	0.53	0.52	0.51	0.53	0.54	0.54	0.54	0.54	0.54	0.54	0.53	0.53	0.53	0.53	
15.0 N	0.53	0.53	0.53	0.53	0.52	0.53	0.51	0.48	0.51	0.54	0.54	0.54	0.52	0.50	0.54	0.53	0.53	0.54	0.53	0.53	0.53	0.53	0.53	0.54	0.54	
12.5 N	0.54	0.52	0.53	0.53	0.52	0.53	0.52	0.49	0.50	0.54	0.53	0.53	0.52	0.51	0.53	0.52	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.52	0.53	
10.0 N	0.53	0.52	0.52	0.52	0.53	0.53	0.53	0.54	0.53	0.53	0.52	0.52	0.52	0.51	0.50	0.52	0.53	0.52	0.53	0.52	0.53	0.53	0.53	0.53	0.53	
7.5 N	0.52	0.53	0.52	0.52	0.54	0.52	0.52	0.53	0.51	0.52	0.52	0.52	0.53	0.51	0.51	0.53	0.52	0.52	0.53	0.52	0.53	0.52	0.51	0.52	0.53	
5.0 N	0.51	0.52	0.50	0.50	0.52	0.52	0.53	0.52	0.53	0.53	0.50	0.51	0.53	0.52	0.52	0.52	0.52	0.52	0.53	0.52	0.53	0.53	0.53	0.52	0.52	
2.5 N	0.52	0.52	0.50	0.50	0.50	0.53	0.54	0.51	0.54	0.50	0.46	0.51	0.53	0.51	0.52	0.52	0.52	0.52	0.51	0.52	0.51	0.51	0.52	0.53	0.52	
0.0 N	0.51	0.52	0.52	0.52	0.52	0.53	0.54	0.52	0.53	0.49	0.48	0.53	0.49	0.49	0.51	0.51	0.52	0.51	0.52	0.53	0.53	0.52	0.51	0.52	0.52	
2.5 S	0.52	0.52	0.52	0.52	0.51	0.51	0.54	0.53	0.53	0.53	0.54	0.53	0.47	0.49	0.52	0.51	0.51	0.52	0.50	0.51	0.49	0.5	0.52	0.53	0.54	0.52
5.0 S	0.52	0.52	0.52	0.53	0.52	0.52	0.53	0.52	0.52	0.53	0.53	0.52	0.50	0.52	0.52	0.51	0.52	0.51	0.52	0.51	0.48	0.47	0.45	0.44	0.5	0.52
7.5 S	0.52	0.52	0.52	0.53	0.53	0.53	0.53	0.52	0.51	0.51	0.51	0.52	0.52	0.51	0.50	0.50	0.51	0.52	0.52	0.53	0.49	0.43	0.45	0.45	0.51	0.51
10.0 S	0.53	0.53	0.52	0.52	0.53	0.53	0.53	0.53	0.52	0.52	0.52	0.52	0.51	0.50	0.50	0.49	0.49	0.48	0.48	0.5	0.51	0.51	0.52	0.49	0.51	0.51
12.5 S	0.51	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.51	0.50	0.50	0.48	0.47	0.44	0.42	0.45	0.49	0.46	0.47	0.51	0.51	0.5

October

	90.0 E	92.5 E	95.0 E	97.5 E	100.0 E	102.5 E	105.0 E	107.5 E	110.0 E	112.5 E	115.0 E	117.5 E	120.0 E	122.5 E	125.0 E	127.5 E	130.0 E	132.5 E	135.0 E	137.5 E	140.0 E	142.5 E	145.0 E	147.5 E	150.0 E	
25.0 N	0.52	0.47	0.47	0.41	0.32	0.32	0.36	0.40	0.44	0.43	0.43	0.45	0.47	0.50	0.51	0.51	0.52	0.52	0.52	0.52	0.53	0.53	0.53	0.53	0.53	0.53
22.5 N	0.53	0.48	0.45	0.42	0.39	0.39	0.43	0.48	0.48	0.46	0.49	0.51	0.50	0.51	0.52	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.54	0.53	0.53
20.0 N	0.52	0.52	0.50	0.46	0.42	0.42	0.47	0.51	0.51	0.50	0.53	0.53	0.52	0.54	0.53	0.53	0.53	0.54	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53
17.5 N	0.51	0.52	0.53	0.50	0.47	0.48	0.50	0.51	0.53	0.53	0.53	0.52	0.51	0.52	0.53	0.54	0.53	0.54	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53
15.0 N	0.52	0.51	0.52	0.52	0.51	0.52	0.50	0.49	0.52	0.54	0.53	0.54	0.51	0.51	0.54	0.53	0.53	0.54	0.53	0.53	0.53	0.53	0.53	0.53	0.54	0.54
12.5 N	0.52	0.51	0.53	0.53	0.52	0.53	0.52	0.50	0.52	0.53	0.53	0.53	0.52	0.52	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.52	0.53	0.53
10.0 N	0.52	0.51	0.52	0.51	0.52	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.52	0.52	0.51	0.51	0.52	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53
7.5 N	0.52	0.52	0.52	0.52	0.53	0.52	0.52	0.53	0.53	0.51	0.53	0.52	0.52	0.51	0.51	0.53	0.53	0.52	0.53	0.52	0.53	0.52	0.51	0.52	0.53	0.53
5.0 N	0.51	0.51	0.50	0.50	0.51	0.52	0.53	0.52	0.53	0.53	0.50	0.51	0.53	0.52	0.52	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.52
2.5 N	0.52	0.52	0.51	0.50	0.50	0.53	0.54	0.51	0.54	0.51	0.46	0.51	0.53	0.51	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.51	0.52	0.53	0.53	0.53
0.0 N	0.51	0.52	0.52	0.52	0.52	0.53	0.54	0.52	0.53	0.49	0.48	0.53	0.50	0.49	0.52	0.51	0.51	0.52	0.53	0.54	0.54	0.53	0.52	0.51	0.52	0.52
2.5 S	0.52	0.52	0.52	0.51	0.51	0.54	0.53	0.53	0.53	0.53	0.54	0.53	0.47	0.49	0.52	0.51	0.52	0.51	0.52	0.51	0.49	0.5	0.52	0.54	0.54	0.52
5.0 S	0.52	0.52	0.53	0.52	0.52	0.52	0.53	0.51	0.52	0.53	0.53	0.54	0.51	0.52	0.52	0.53	0.52	0.53	0.52	0.53	0.52	0.53	0.52	0.51	0.52	0.53
7.5 S	0.52	0.52	0.52	0.52	0.53	0.53	0.53	0.52	0.52	0.52	0.51	0.52	0.52	0.51	0.51	0.51	0.52	0.52	0.53	0.53	0.54	0.54	0.54	0.54	0.54	0.51
10.0 S	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.53	0.53	0.53	0.53	0.53	0.52	0.51	0.51	0.52	0.52	0.52	0.52	0.51	0.51	0.51	0.53	0.53	0.51	0.51
12.5 S	0.52	0.51	0.51	0.52	0.51	0.51	0.51	0.52	0.52	0.52	0.53	0.54	0.53	0.54	0.53	0.54	0.53	0.54	0.51	0.47	0.47	0.52	0.52	0.53	0.53	0.53

ECM 1991 - 2000 Angle Error 3° Elevation (°)

South East Asia

January

	90.0 E	92.5 E	95.0 E	97.5 E	100.0 E	102.5 E	105.0 E	107.5 E	110.0 E	112.5 E	115.0 E	117.5 E	120.0 E	122.5 E	125.0 E	127.5 E	130.0 E	132.5 E	135.0 E	137.5 E	140.0 E	142.5 E	145.0 E	147.5 E	150.0 E
25.0 N	0.19	0.17	0.17	0.16	0.13	0.13	0.15	0.17	0.18	0.18	0.18	0.18	0.20	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21
22.5 N	0.19	0.17	0.15	0.15	0.15	0.16	0.18	0.19	0.19	0.19	0.20	0.21	0.21	0.21	0.22	0.22	0.22	0.21	0.21	0.21	0.22	0.22	0.22	0.22	0.22
20.0 N	0.20	0.19	0.18	0.17	0.16	0.17	0.19	0.21	0.21	0.21	0.22	0.23	0.22	0.23	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.23	0.23	0.23	0.23
17.5 N	0.20	0.21	0.20	0.18	0.18	0.19	0.20	0.22	0.23	0.23	0.23	0.23	0.22	0.22	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23
15.0 N	0.21	0.22	0.21	0.20	0.20	0.20	0.20	0.21	0.22	0.23	0.23	0.24	0.23	0.22	0.24	0.24	0.23	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24
12.5 N	0.23	0.22	0.23	0.22	0.21	0.21	0.20	0.20	0.22	0.24	0.24	0.24	0.24	0.23	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24
10.0 N	0.23	0.23	0.23	0.23	0.22	0.22	0.22	0.22	0.23	0.24	0.24	0.24	0.24	0.23	0.23	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24
7.5 N	0.24	0.24	0.23	0.23	0.23	0.23	0.23	0.23	0.24	0.24	0.24	0.24	0.24	0.24	0.23	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24
5.0 N	0.23	0.24	0.23	0.23	0.23	0.23	0.24	0.24	0.24	0.24	0.23	0.23	0.24	0.24	0.23	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24
2.5 N	0.24	0.24	0.23	0.23	0.23	0.23	0.24	0.23	0.24	0.23	0.21	0.23	0.24	0.23	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.23	0.24	0.24	0.24
0.0 N	0.23	0.23	0.24	0.23	0.23	0.24	0.24	0.24	0.24	0.24	0.23	0.22	0.24	0.23	0.22	0.23	0.23	0.24	0.23	0.23	0.24	0.24	0.24	0.23	0.24
2.5 S	0.23	0.23	0.23	0.23	0.23	0.23	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.22	0.23	0.24	0.23	0.23	0.24	0.23	0.22	0.23	0.23	0.24	0.24
5.0 S	0.23	0.23	0.23	0.24	0.23	0.23	0.24	0.24	0.23	0.24	0.24	0.24	0.23	0.24	0.24	0.24	0.24	0.23	0.22	0.21	0.21	0.21	0.23	0.24	0.24
7.5 S	0.23	0.24	0.24	0.24	0.24	0.24	0.23	0.23	0.23	0.23	0.23	0.24	0.24	0.23	0.24	0.24	0.24	0.24	0.24	0.24	0.23	0.21	0.22	0.23	0.23
10.0 S	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.23	0.23	0.24	0.24	0.23	0.23	0.24	0.24	0.24	0.24	0.24	0.24	0.25	0.24	0.23	0.23	0.23
12.5 S	0.24	0.24	0.24	0.24	0.24	0.23	0.23	0.23	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.25	0.24	0.24	0.24	0.23	0.24	0.24	0.24	0.24

April

	90.0 E	92.5 E	95.0 E	97.5 E	100.0 E	102.5 E	105.0 E	107.5 E	110.0 E	112.5 E	115.0 E	117.5 E	120.0 E	122.5 E	125.0 E	127.5 E	130.0 E	132.5 E	135.0 E	137.5 E	140.0 E	142.5 E	145.0 E	147.5 E	150.0 E
25.0 N	0.19	0.18	0.19	0.17	0.13	0.14	0.16	0.19	0.21	0.21	0.21	0.21	0.21	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.23	0.23
22.5 N	0.21	0.18	0.16	0.16	0.16	0.17	0.19	0.22	0.22	0.22	0.23	0.23	0.22	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23
20.0 N	0.25	0.22	0.19	0.17	0.18	0.19	0.21	0.23	0.23	0.23	0.24	0.24	0.23	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24
17.5 N	0.24	0.24	0.21	0.20	0.21	0.22	0.23	0.23	0.24	0.24	0.24	0.24	0.24	0.23	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24
15.0 N	0.24	0.24	0.23	0.22	0.23	0.24	0.23	0.22	0.24	0.25	0.24	0.24	0.24	0.23	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24
12.5 N	0.24	0.24	0.25	0.24	0.23	0.24	0.23	0.22	0.23	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24
10.0 N	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.25	0.24	0.24	0.24	0.24	0.23	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24
7.5 N	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.23	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24
5.0 N	0.23	0.24	0.23	0.23	0.24	0.24	0.24	0.24	0.24	0.25	0.23	0.23	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24
2.5 N	0.24	0.24	0.23	0.23	0.23	0.24	0.24	0.24	0.24	0.24	0.23	0.23	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24
0.0 N	0.23	0.24	0.24	0.24	0.24	0.24	0.25	0.24	0.24	0.23	0.22	0.24	0.23	0.23	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24
2.5 S	0.23	0.24	0.23	0.23	0.23	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.22	0.23	0.24	0.24	0.24	0.23	0.23	0.24	0.24	0.24	0.24
5.0 S	0.24	0.24	0.24	0.24	0.23	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.23	0.24	0.24	0.24	0.24	0.22	0.22	0.21	0.21	0.23	0.24
7.5 S	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.23	0.23	0.24	0.24	0.24	0.24	0.23	0.24	0.24	0.24	0.24	0.24	0.24	0.25	0.23	0.21
10.0 S	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.23	0.23	0.24	0.24	0.24	0.24	0.24	0.24	0.25	0.24	0.23
12.5 S	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.23	0.23	0.23	0.23	0.23	0.23	0.24	0.24	0.24

July

	90.0 E	92.5 E	95.0 E	97.5 E	100.0 E	102.5 E	105.0 E	107.5 E	110.0 E	112.5 E	115.0 E	117.5 E	120.0 E	122.5 E	125.0 E	127.5 E	130.0 E	132.5 E	135.0 E	137.5 E	140.0 E	142.5 E	145.0 E	147.5 E	150.0 E	
25.0 N	0.25	0.23	0.22	0.20	0.17	0.17	0.18	0.21	0.23	0.23	0.23	0.23	0.23	0.24	0.25	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	
22.5 N	0.25	0.23	0.21	0.20	0.19	0.19	0.21	0.24	0.25	0.24	0.25	0.25	0.24	0.24	0.24	0.24	0.25	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	
20.0 N	0.25	0.24	0.23	0.22	0.20	0.21	0.23	0.24	0.25	0.24	0.25	0.25	0.24	0.25	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	
17.5 N	0.24	0.24	0.24	0.23	0.22	0.23	0.23	0.23	0.24	0.25	0.24	0.24	0.23	0.23	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	
15.0 N	0.24	0.24	0.24	0.24	0.23	0.24	0.23	0.22	0.23	0.24	0.24	0.24	0.23	0.23	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	
12.5 N	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.22	0.23	0.24	0.24	0.24	0.24	0.24	0.23	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	
10.0 N	0.24	0.24	0.23	0.23	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.23	0.24	0.23	0.23	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	
7.5 N	0.24	0.24	0.23	0.23	0.24	0.23	0.24	0.24	0.23	0.24	0.24	0.23	0.24	0.23	0.23	0.24	0.24	0.24	0.23	0.24	0.24	0.24	0.24	0.23	0.24	
5.0 N	0.23	0.23	0.23	0.23	0.23	0.24	0.24	0.23	0.24	0.24	0.23	0.23	0.24	0.24	0.24	0.24	0.24	0.24	0.23	0.24	0.24	0.24	0.24	0.24	0.23	
2.5 N	0.23	0.23	0.23	0.23	0.23	0.24	0.24	0.23	0.24	0.23	0.21	0.23	0.24	0.23	0.23	0.23	0.24	0.23	0.23	0.23	0.23	0.23	0.23	0.24	0.24	
0.0 N	0.23	0.23	0.23	0.24	0.23	0.24	0.24	0.23	0.24	0.22	0.22	0.24	0.22	0.22	0.23	0.23	0.23	0.23	0.23	0.24	0.24	0.24	0.23	0.23	0.23	
2.5 S	0.23	0.23	0.23	0.23	0.23	0.23	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.22	0.22	0.23	0.23	0.23	0.23	0.23	0.22	0.23	0.23	0.24	0.24	
5.0 S	0.24	0.24	0.24	0.24	0.23	0.23	0.24	0.23	0.23	0.24	0.24	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.24	0.23	0.22	0.21	0.21	0.2	0.23	0.24
7.5 S	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.24	0.24	0.24	0.22	0.2	0.21	0.21	0.23
10.0 S	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.23	0.23	0.23	0.23	0.23	0.23	0.22	0.22	0.22	0.22	0.23	0.23	0.23	0.24	0.23	0.22	0.23
12.5 S	0.23	0.23	0.24	0.24	0.24	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.22	0.22	0.21	0.20	0.19	0.21	0.22	0.21	0.21	0.23	0.23	0.23

October

	90.0 E	92.5 E	95.0 E	97.5 E	100.0 E	102.5 E	105.0 E	107.5 E	110.0 E	112.5 E	115.0 E	117.5 E	120.0 E	122.5 E	125.0 E	127.5 E	130.0 E	132.5 E	135.0 E	137.5 E	140.0 E	142.5 E	145.0 E	147.5 E	150.0 E	
25.0 N	0.23	0.22	0.21	0.19	0.16	0.16	0.17	0.19	0.20	0.20	0.20	0.21	0.22	0.23	0.23	0.23	0.23	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	
22.5 N	0.24	0.22	0.21	0.20	0.18	0.18	0.20	0.22	0.22	0.21	0.22	0.23	0.23	0.23	0.23	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	
20.0 N	0.24	0.23	0.23	0.21	0.19	0.20	0.21	0.23	0.23	0.23	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	
17.5 N	0.23	0.24	0.24	0.23	0.22	0.22	0.23	0.23	0.24	0.24	0.24	0.24	0.23	0.23	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	
15.0 N	0.23	0.23	0.24	0.24	0.23	0.23	0.23	0.22	0.24	0.24	0.24	0.24	0.23	0.23	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	
12.5 N	0.24	0.23	0.24	0.24	0.23	0.24	0.23	0.23	0.23	0.24	0.24	0.24	0.24	0.24	0.23	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	
10.0 N	0.23	0.23	0.23	0.23	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.23	0.23	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	
7.5 N	0.23	0.24	0.23	0.23	0.24	0.23	0.24	0.24	0.23	0.24	0.24	0.23	0.23	0.24	0.23	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.23	0.24	
5.0 N	0.23	0.23	0.23	0.23	0.23	0.24	0.24	0.23	0.24	0.24	0.23	0.23	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.23	
2.5 N	0.23	0.23	0.23	0.23	0.24	0.24	0.23	0.24	0.23	0.21	0.23	0.24	0.23	0.24	0.23	0.23	0.24	0.23	0.24	0.23	0.24	0.23	0.23	0.24	0.24	
0.0 N	0.23	0.23	0.24	0.23	0.23	0.24	0.24	0.23	0.24	0.23	0.22	0.24	0.23	0.22	0.23	0.23	0.23	0.23	0.24	0.24	0.24	0.24	0.24	0.23	0.23	
2.5 S	0.23	0.23	0.23	0.23	0.23	0.23	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.22	0.22	0.24	0.23	0.23	0.24	0.23	0.22	0.23	0.24	0.24	0.23	0.23
5.0 S	0.24	0.24	0.24	0.24	0.24	0.23	0.24	0.23	0.23	0.24	0.24	0.24	0.24	0.23	0.24	0.24	0.23	0.24	0.23	0.22	0.22	0.21	0.21	0.23	0.24	
7.5 S	0.23	0.23	0.23	0.24	0.24	0.24	0.24	0.23	0.24	0.23	0.23	0.24	0.24	0.23	0.23	0.23	0.24	0.24	0.24	0.24	0.24	0.23	0.23	0.21	0.23	
10.0 S	0.23	0.23	0.23	0.23	0.23	0.23	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.24	0.23	0.24	0.23	0.23	
12.5 S	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.23	0.21	0.21	0.23	0.22	0.21	0.23	0.24	

ECM 1991 - 2000 Angle Error 5° Elevation (°)

South East Asia

January

	90.0 E	92.5 E	95.0 E	97.5 E	100.0 E	102.5 E	105.0 E	107.5 E	110.0 E	112.5 E	115.0 E	117.5 E	120.0 E	122.5 E	125.0 E	127.5 E	130.0 E	132.5 E	135.0 E	137.5 E	140.0 E	142.5 E	145.0 E	147.5 E	150.0 E
25.0 N	0.13	0.12	0.12	0.11	0.09	0.09	0.10	0.12	0.13	0.12	0.12	0.13	0.14	0.14	0.15	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.15
22.5 N	0.13	0.12	0.11	0.11	0.11	0.11	0.12	0.13	0.13	0.13	0.14	0.15	0.14	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
20.0 N	0.14	0.13	0.12	0.12	0.11	0.12	0.13	0.14	0.15	0.15	0.16	0.16	0.15	0.16	0.16	0.15	0.15	0.15	0.15	0.15	0.15	0.16	0.16	0.16	0.16
17.5 N	0.14	0.15	0.14	0.13	0.13	0.14	0.15	0.16	0.16	0.16	0.16	0.16	0.15	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16
15.0 N	0.15	0.15	0.14	0.14	0.14	0.14	0.14	0.14	0.15	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.17	0.17	0.17
12.5 N	0.16	0.15	0.16	0.15	0.14	0.14	0.14	0.14	0.15	0.16	0.16	0.16	0.16	0.16	0.16	0.17	0.16	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17
10.0 N	0.16	0.16	0.16	0.16	0.15	0.15	0.15	0.16	0.17	0.16	0.16	0.16	0.16	0.16	0.16	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17
7.5 N	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.17	0.17	0.17	0.16	0.16	0.16	0.16	0.17	0.17	0.16	0.17	0.17	0.17	0.17	0.17	0.17	0.17
5.0 N	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.17	0.17	0.16	0.16	0.17	0.16	0.16	0.17	0.17	0.17	0.16	0.17	0.17	0.17	0.17	0.17	0.16
2.5 N	0.16	0.16	0.16	0.16	0.16	0.17	0.16	0.17	0.17	0.16	0.15	0.16	0.17	0.16	0.16	0.16	0.17	0.16	0.16	0.16	0.16	0.16	0.17	0.17	0.17
0.0 N	0.16	0.16	0.16	0.16	0.16	0.17	0.16	0.17	0.17	0.16	0.15	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.17	0.17	0.17	0.16	0.16
2.5 S	0.16	0.16	0.16	0.16	0.16	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.15	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.17	0.17	0.16
5.0 S	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.17	0.17	0.16	0.16	0.16	0.17	0.17	0.17	0.16	0.15	0.15	0.15	0.15	0.16	0.16	0.16
7.5 S	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.17	0.16	0.17	0.17	0.17	0.16	0.14	0.15	0.16	0.16
10.0 S	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.16	0.16
12.5 S	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.16

April

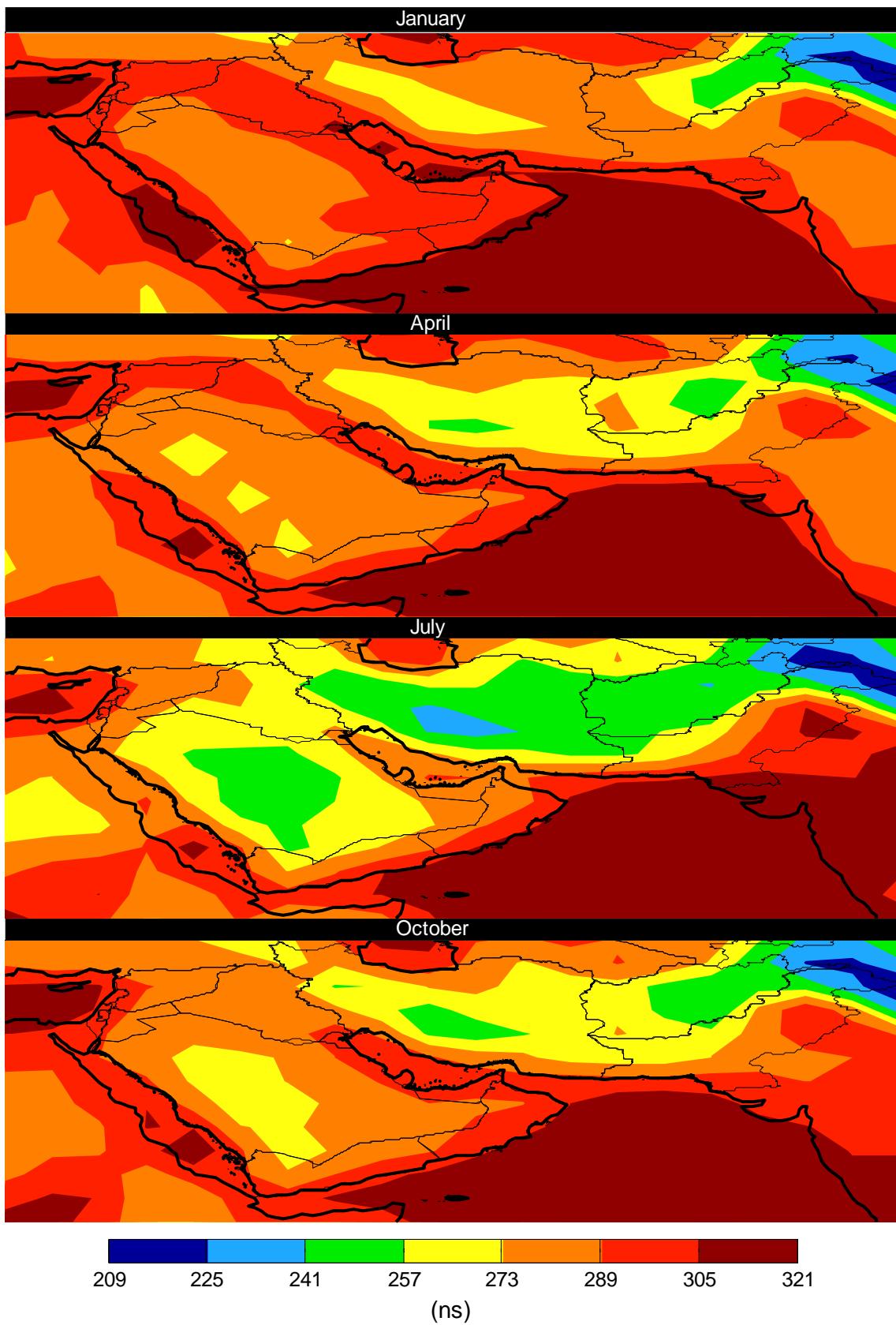
	90.0 E	92.5 E	95.0 E	97.5 E	100.0 E	102.5 E	105.0 E	107.5 E	110.0 E	112.5 E	115.0 E	117.5 E	120.0 E	122.5 E	125.0 E	127.5 E	130.0 E	132.5 E	135.0 E	137.5 E	140.0 E	142.5 E	145.0 E	147.5 E	150.0 E
25.0 N	0.14	0.13	0.13	0.12	0.09	0.09	0.11	0.13	0.14	0.14	0.14	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.16	0.16	0.16	0.16
22.5 N	0.15	0.13	0.11	0.11	0.11	0.12	0.13	0.15	0.16	0.15	0.16	0.16	0.15	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16
20.0 N	0.17	0.15	0.13	0.12	0.13	0.13	0.15	0.16	0.16	0.16	0.17	0.17	0.16	0.17	0.16	0.17	0.16	0.17	0.16	0.17	0.16	0.16	0.16	0.16	0.16
17.5 N	0.17	0.17	0.15	0.14	0.14	0.15	0.16	0.16	0.17	0.17	0.17	0.17	0.16	0.16	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.16
15.0 N	0.16	0.17	0.16	0.16	0.16	0.16	0.16	0.15	0.16	0.17	0.17	0.17	0.16	0.16	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17
12.5 N	0.17	0.17	0.17	0.17	0.16	0.17	0.16	0.15	0.16	0.17	0.17	0.17	0.16	0.16	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17
10.0 N	0.17	0.16	0.17	0.17	0.16	0.17	0.16	0.16	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17
7.5 N	0.16	0.17	0.17	0.16	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17
5.0 N	0.16	0.16	0.16	0.16	0.16	0.17	0.17	0.17	0.17	0.17	0.16	0.16	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.16
2.5 N	0.16	0.16	0.16	0.16	0.16	0.17	0.17	0.17	0.16	0.17	0.16	0.15	0.16	0.17	0.16	0.16	0.17	0.17	0.16	0.17	0.16	0.16	0.17	0.17	0.17
0.0 N	0.16	0.16	0.16	0.16	0.16	0.17	0.17	0.16	0.17	0.16	0.15	0.17	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.17	0.17	0.16	0.16	0.16
2.5 S	0.16	0.16	0.16	0.16	0.16	0.16	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.16	0.16	0.16	0.16	0.16	0.17	0.17	0.17	0.17	0.16
5.0 S	0.16	0.16	0.16	0.17	0.16	0.16	0.17	0.17	0.16	0.16	0.16	0.16	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.15	0.15	0.16
7.5 S	0.16	0.17	0.16	0.17	0.17	0.17	0.17	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.17	0.17	0.17	0.16	0.15	0.16
10.0 S	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.17	0.17	0.17	0.17	0.16
12.5 S	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.16

Appendix C

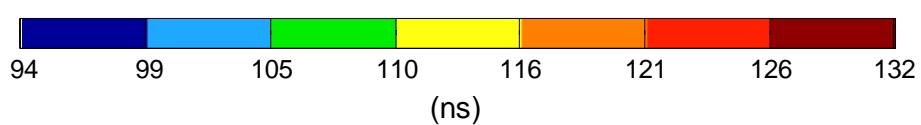
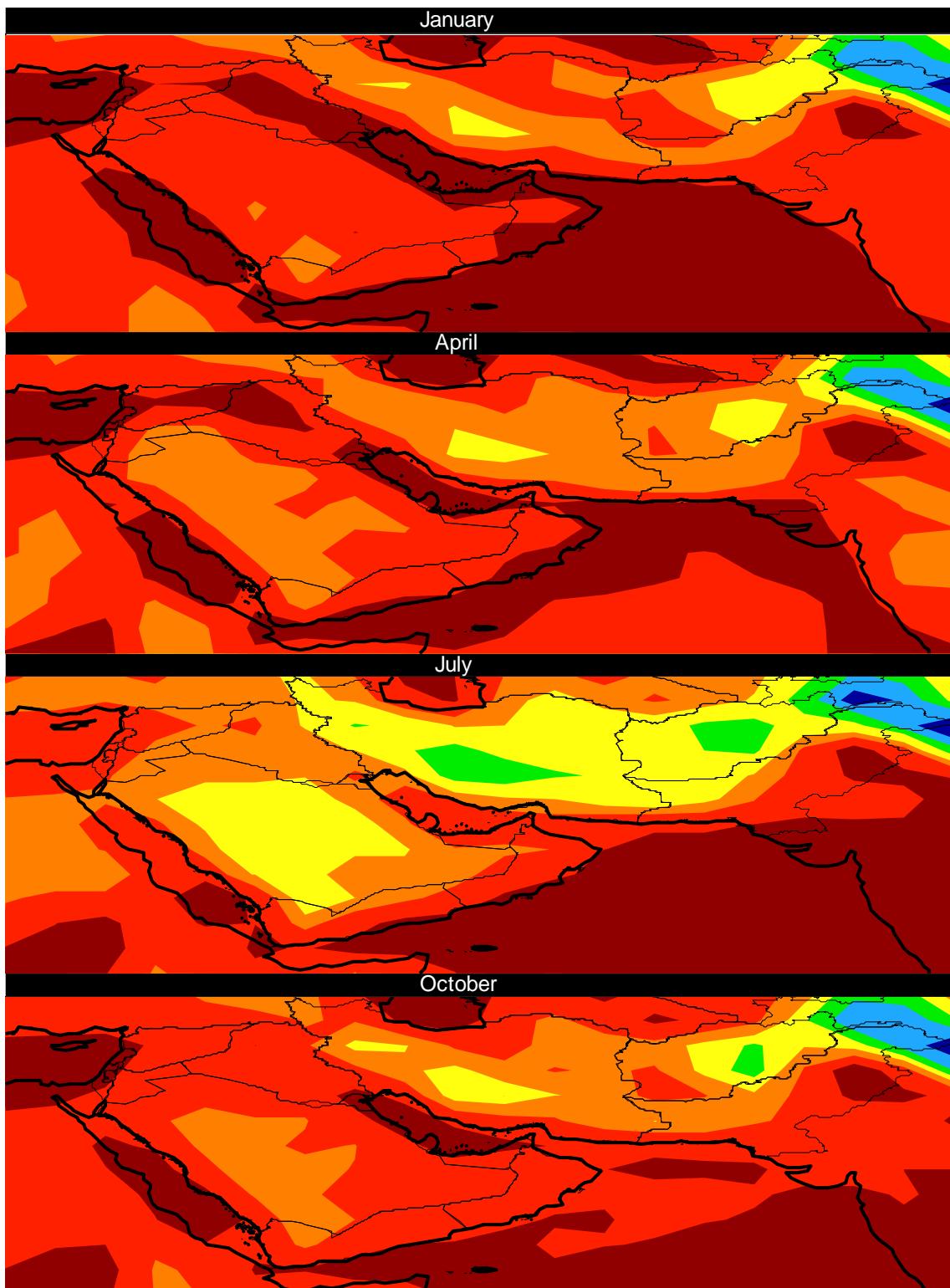
**ECM 1991-2000 TIME DELAYS
JANUARY, APRIL, JULY, OCTOBER
0, 1, 3, AND 5° ELEVATION ANGLES**

**MIDDLE EAST
AMAZON RAINFOREST
NORTH ASIA
SOUTH ASIA**

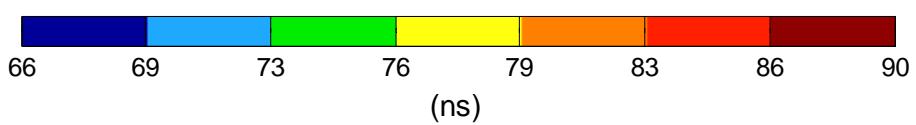
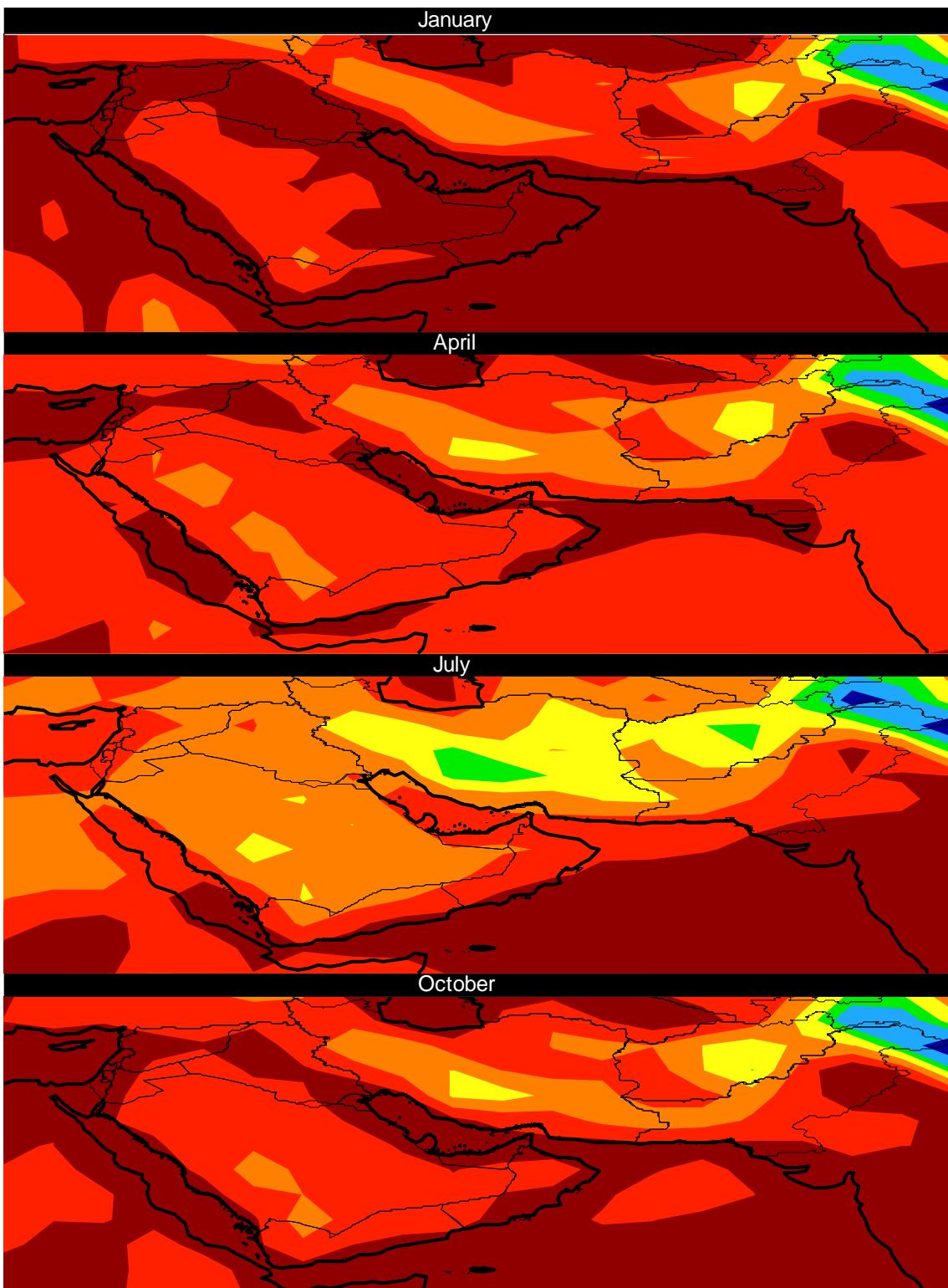
ECM 1991-2000 Time Delay 0° Elevation
Middle East



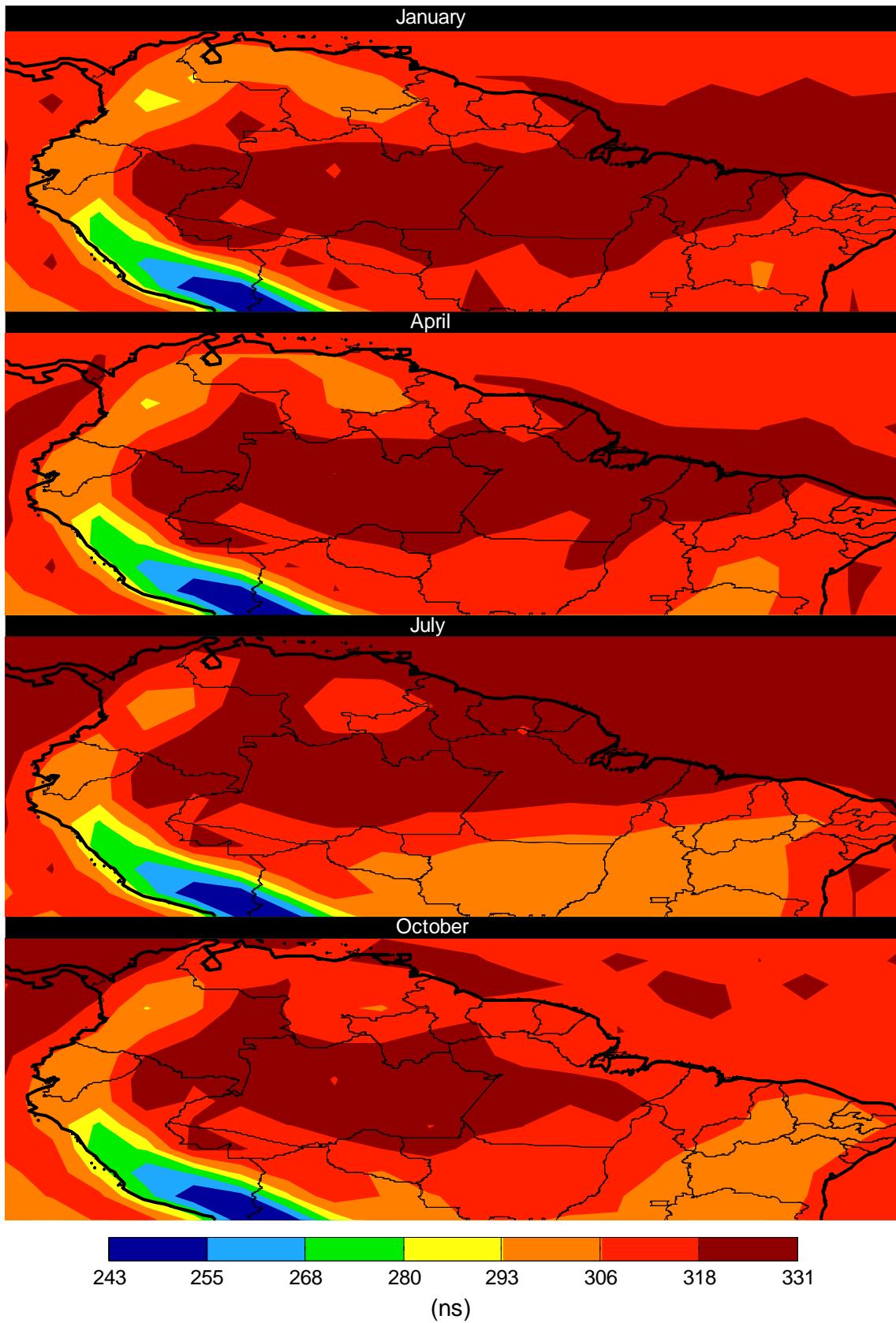
ECM 1991-2000 Time Delay 3° Elevation
Middle East



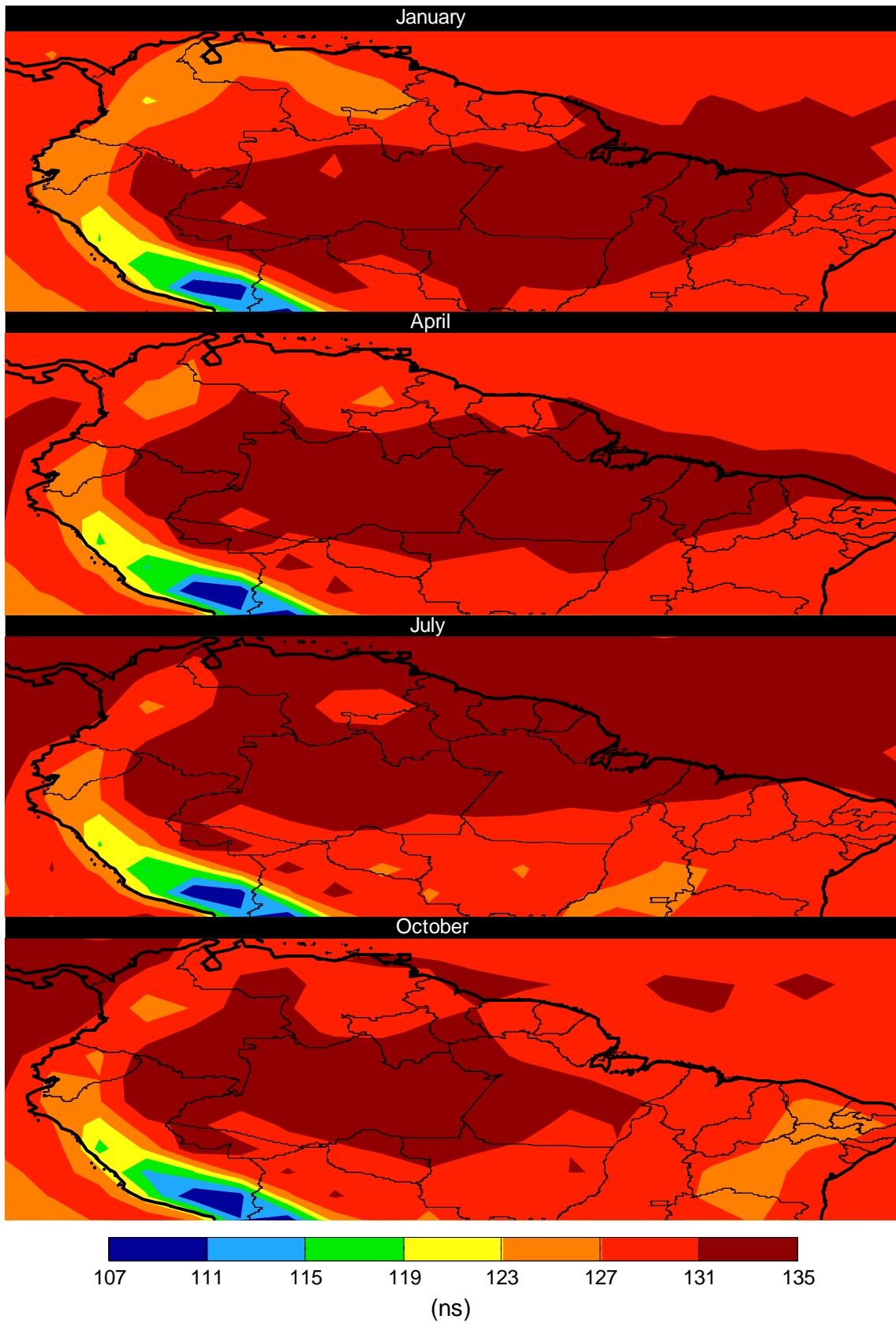
ECM 1991-2000 Time Delay 5° Elevation
Middle East



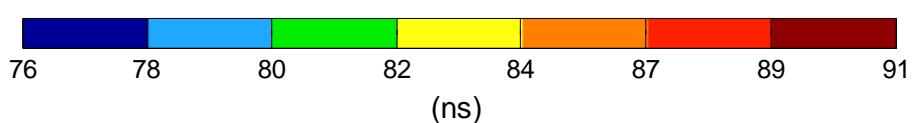
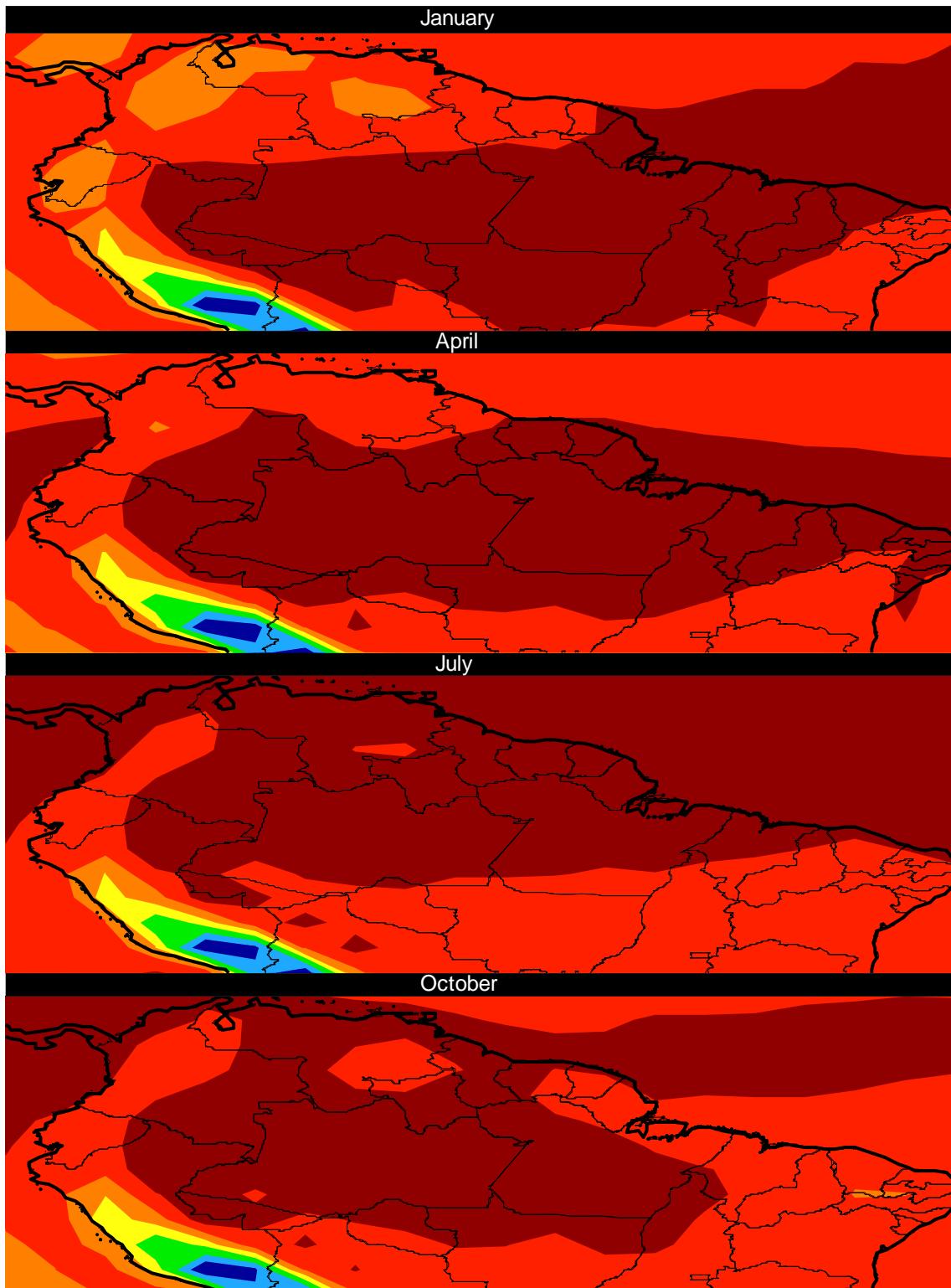
ECM 1991-2000 Time Delay 0° Elevation
Amazon Rainforest



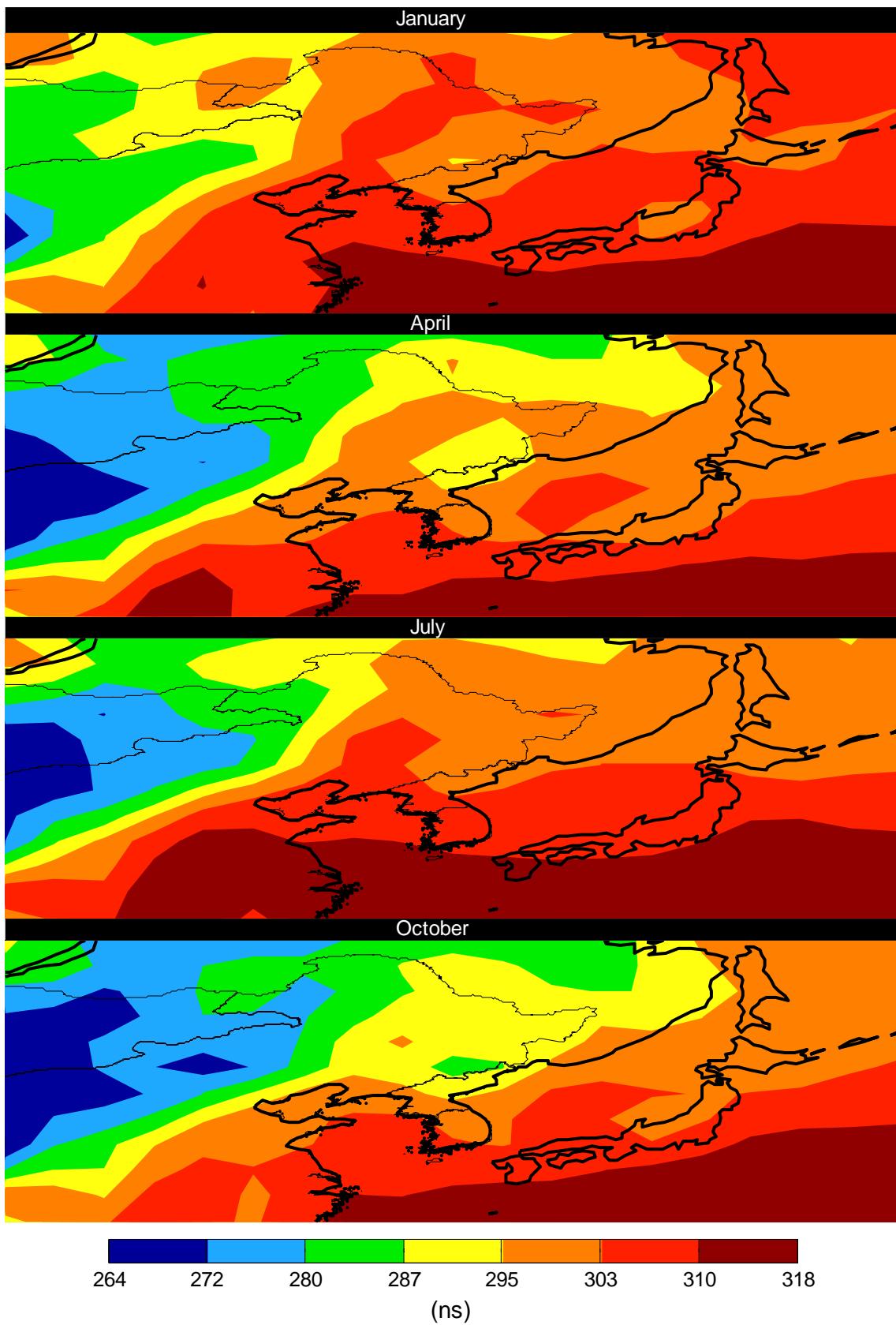
ECM 1991-2000 Time Delay 3° Elevation
Amazon Rainforest



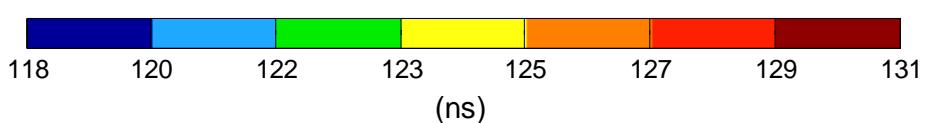
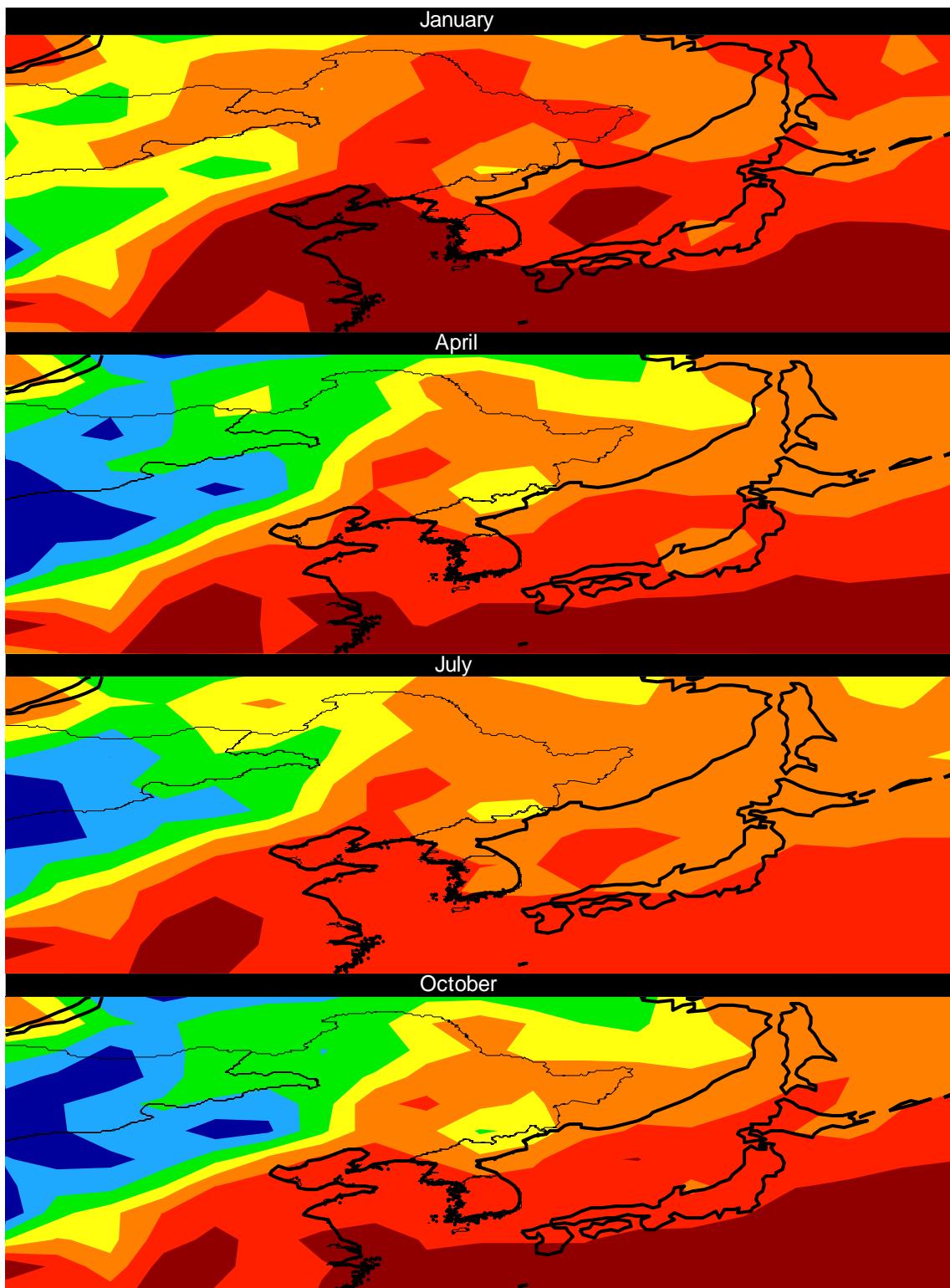
ECM 1991-2000 Time Delay 5° Elevation
Amazon Rainforest



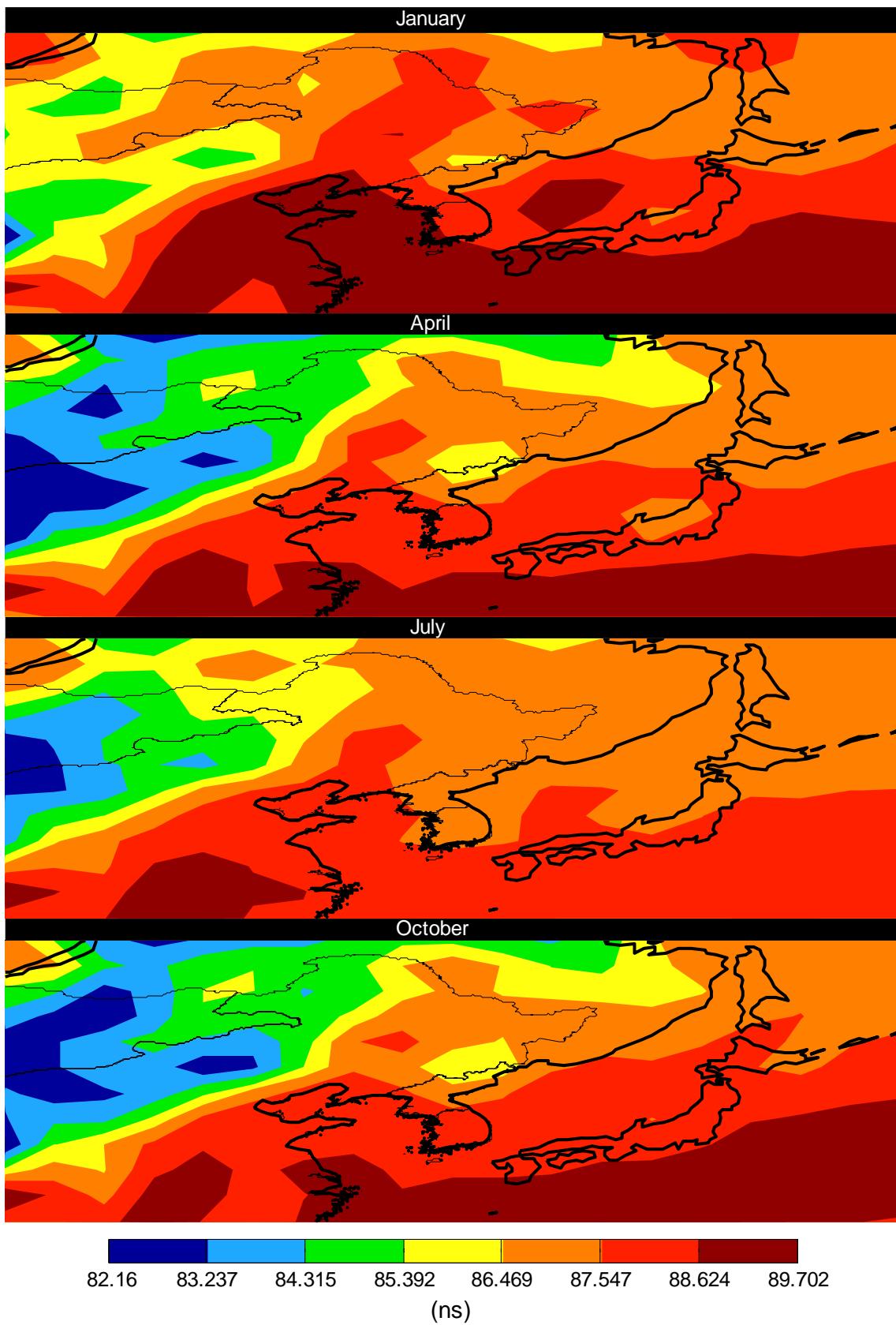
ECM 1991-2000 Time Delay 0° Elevation
North Asia



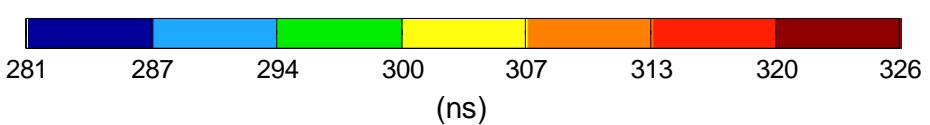
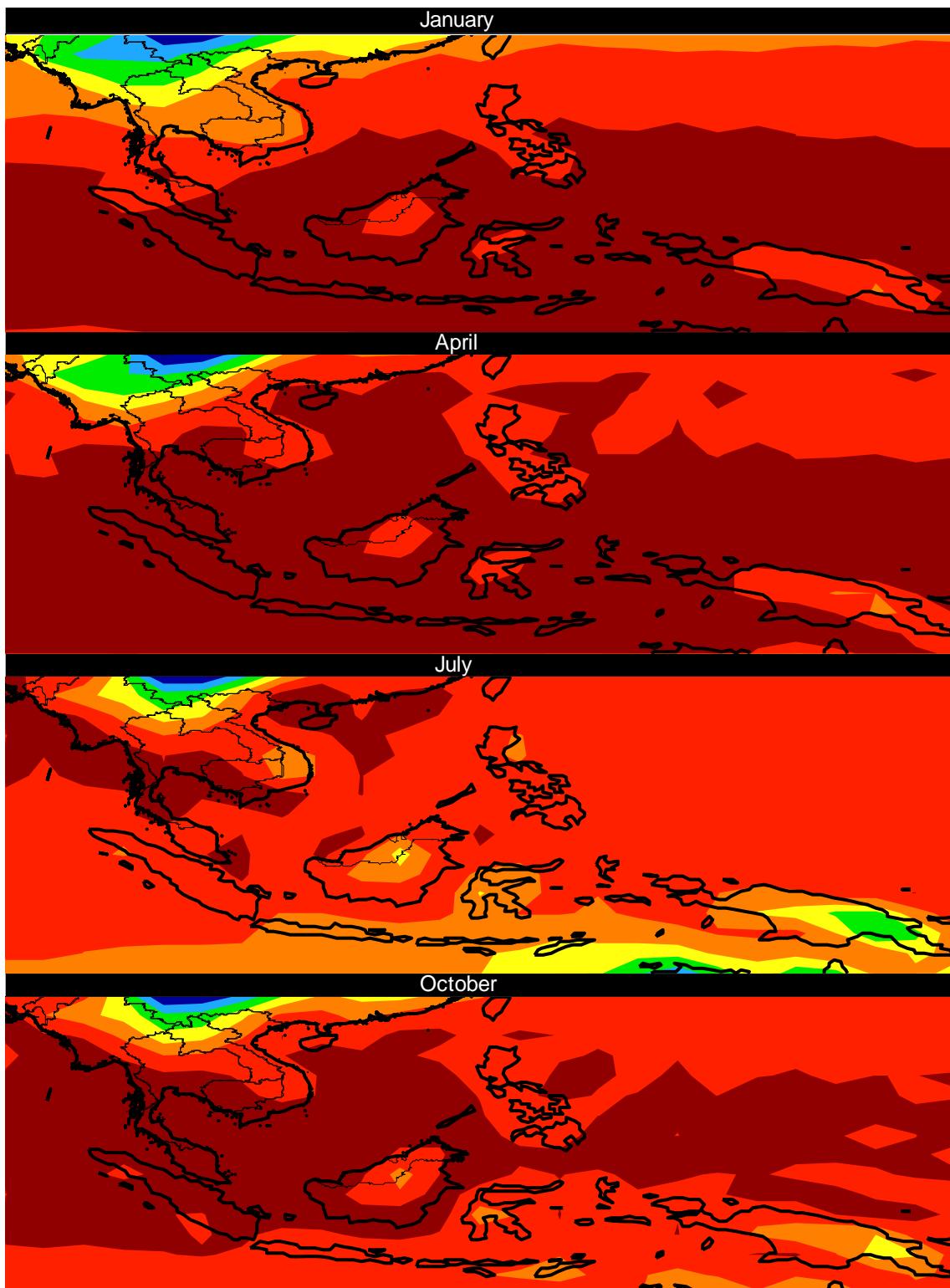
ECM 1991-2000 Time Delay 3° Elevation
North Asia



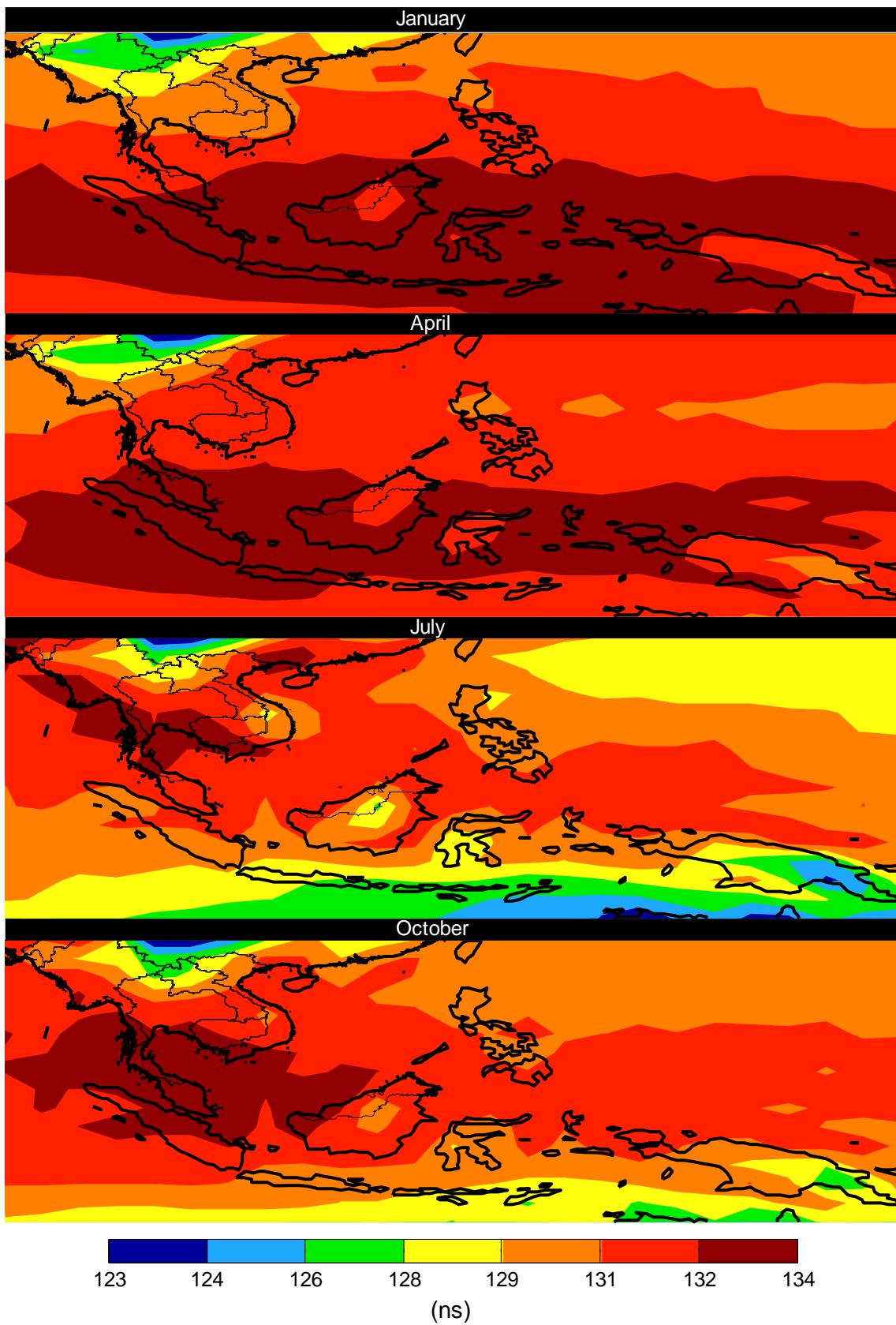
ECM 1991-2000 Time Delay 5° Elevation
North Asia



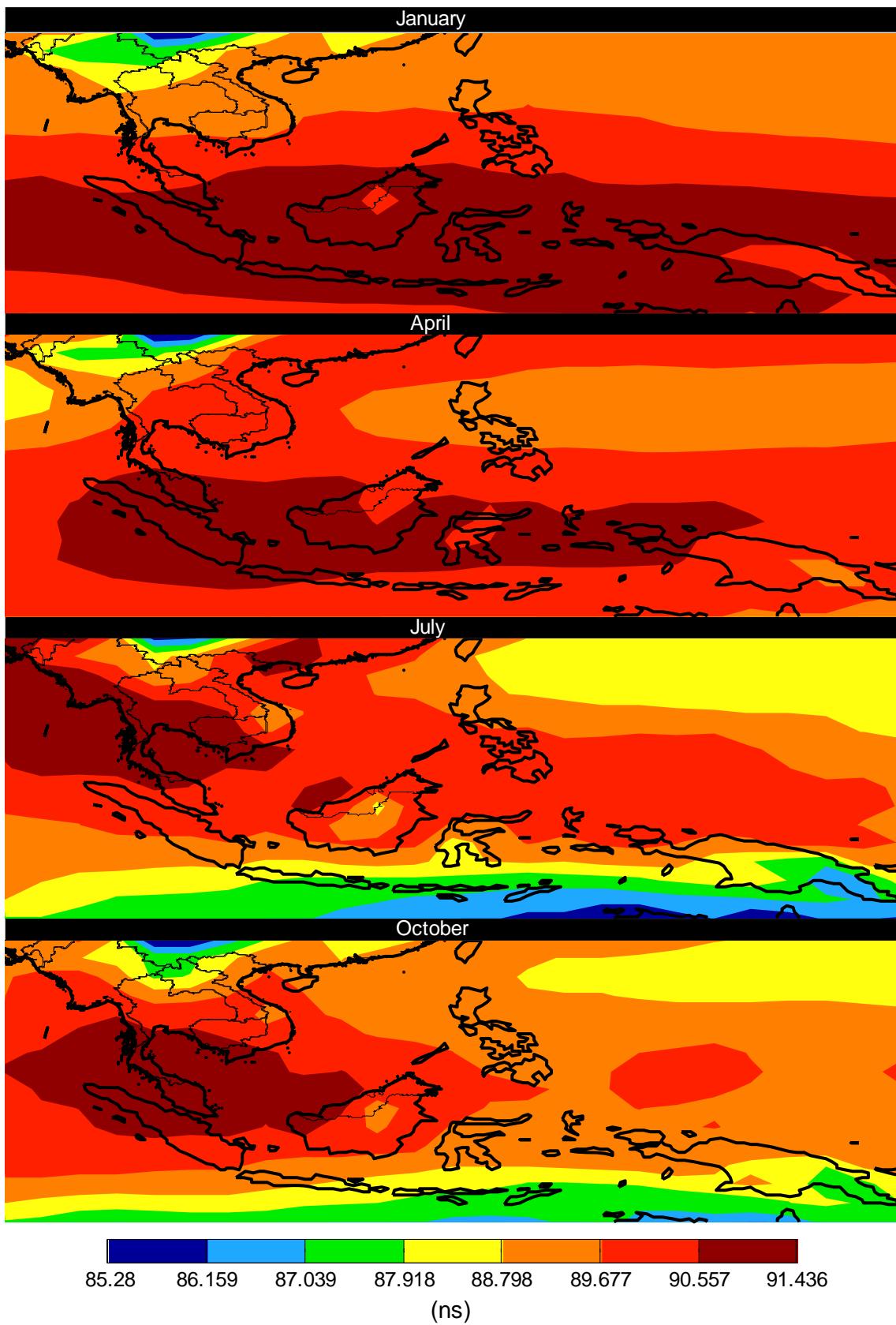
ECM 1991-2000 Time Delay 0° Elevation
South Asia



ECM 1991-2000 Time Delay 3° Elevation
South Asia



ECM 1991-2000 Time Delay 5° Elevation
South Asia



ECM 1991 - 2000 Time Delay 0° Elevation (ns)

Middle East

January

	30.0 E	32.5 E	35.0 E	37.5 E	40.0 E	42.5 E	45.0 E	47.5 E	50.0 E	52.5 E	55.0 E	57.5 E	60.0 E	62.5 E	65.0 E	67.5 E	70.0 E	72.5 E	75.0 E	77.5 E
40.0 N	287.67	276.83	277.01	278.33	271.27	262.94	264.22	281.18	302.52	305.07	293.98	293.21	298.60	295.02	290.67	285.19	261.97	237.14	236.49	254.63
37.5 N	287.18	281.36	282.61	282.50	282.74	280.99	271.59	269.76	285.31	295.43	285.31	277.44	285.69	294.29	290.51	274.77	247.31	223.61	220.63	236.84
35.0 N	301.00	303.63	301.88	291.57	291.73	297.83	284.49	263.72	260.67	273.46	281.05	274.61	271.32	272.74	261.74	250.41	252.61	249.11	227.88	207.92
32.5 N	305.65	305.54	296.41	281.68	281.79	293.09	296.50	288.89	270.14	259.84	269.36	276.17	277.42	281.05	264.36	250.23	272.29	297.02	274.45	230.87
30.0 N	298.64	294.47	286.93	278.87	280.64	285.27	290.98	303.64	293.26	263.66	257.73	265.74	271.19	282.49	278.78	266.81	277.61	294.40	293.48	277.81
27.5 N	289.56	288.41	288.85	280.94	276.37	279.79	280.54	291.96	303.69	294.19	285.13	283.51	275.59	270.77	272.00	276.94	282.19	279.20	279.70	289.10
25.0 N	286.94	287.81	298.10	294.55	278.45	279.43	282.09	279.95	292.99	304.95	302.20	300.66	301.04	296.32	292.34	289.46	281.89	278.94	279.45	
22.5 N	286.74	283.26	295.24	306.34	288.80	274.69	279.91	282.11	285.28	294.74	293.23	292.62	302.57	309.26	308.91	303.03	292.21	283.22	283.36	284.30
20.0 N	286.00	282.54	287.56	306.66	305.31	278.69	275.81	288.88	286.99	288.76	296.97	301.94	305.24	303.59	303.36	305.53	304.56	291.51	279.11	284.04
17.5 N	280.35	283.96	287.84	300.93	316.09	289.28	267.07	279.56	283.80	287.99	301.01	307.90	309.91	307.51	306.91	306.00	309.02	301.45	281.99	284.15
15.0 N	272.71	281.32	285.36	279.76	297.52	294.24	278.34	290.56	299.90	305.19	309.46	306.84	306.96	306.21	309.71	306.69	307.17	309.14	292.24	291.79
12.5 N	271.16	279.81	283.24	266.57	279.63	301.72	304.21	310.87	310.08	310.48	310.83	309.01	311.80	307.74	309.85	310.75	310.59	314.46	298.83	290.96
10.0 N	277.10	282.39	282.46	266.40	271.23	289.33	291.12	294.55	301.25	309.62	311.35	309.20	312.64	311.39	311.91	312.50	310.86	313.26	309.33	305.06

April

	30.0 E	32.5 E	35.0 E	37.5 E	40.0 E	42.5 E	45.0 E	47.5 E	50.0 E	52.5 E	55.0 E	57.5 E	60.0 E	62.5 E	65.0 E	67.5 E	70.0 E	72.5 E	75.0 E	77.5 E
40.0 N	289.23	280.25	282.48	284.34	276.70	268.59	270.92	287.37	305.93	304.60	291.37	290.86	295.66	290.39	288.00	288.25	268.02	242.37	240.79	258.32
37.5 N	289.10	284.16	286.94	288.35	289.82	288.66	279.03	276.59	290.10	296.19	283.36	276.68	285.41	292.35	290.19	279.58	253.78	228.08	224.59	241.27
35.0 N	304.61	306.86	303.96	292.94	293.88	300.61	287.21	267.11	263.89	273.96	278.83	272.34	269.53	271.08	262.34	255.42	260.29	256.17	232.31	210.53
32.5 N	309.03	308.75	296.34	278.04	276.74	287.58	291.07	285.46	269.63	259.95	267.61	271.59	271.06	274.24	260.14	250.70	278.47	305.29	280.46	234.05
30.0 N	296.56	292.80	283.27	272.75	273.48	277.71	283.18	296.23	286.73	258.68	253.48	260.40	264.76	274.20	270.83	263.28	279.17	297.98	295.37	278.39
27.5 N	283.33	281.96	281.77	273.72	269.67	273.65	275.34	286.18	295.91	285.35	276.42	275.46	268.24	263.04	265.25	273.86	282.19	279.86	278.28	284.93
25.0 N	278.99	280.01	290.91	288.20	272.39	274.04	277.99	275.45	286.60	297.73	293.62	291.99	296.58	296.59	296.36	299.21	295.36	285.03	277.47	274.27
22.5 N	277.94	276.12	289.85	301.34	282.59	268.43	275.04	277.11	278.65	286.95	284.81	288.16	307.82	319.95	321.09	317.56	305.06	288.68	280.02	276.97
20.0 N	277.45	275.94	282.65	303.33	302.61	275.11	272.22	285.25	282.12	282.80	292.60	303.75	313.81	311.35	308.67	315.09	315.70	296.05	275.56	276.72
17.5 N	272.83	277.99	282.85	299.03	317.54	289.77	265.90	278.42	283.01	288.24	304.16	313.23	315.87	311.19	308.95	311.29	315.56	304.23	279.57	278.36
15.0 N	269.66	281.11	286.55	280.81	296.82	292.19	277.87	293.06	304.52	310.54	314.66	309.62	308.38	308.54	312.10	309.96	311.86	314.89	293.70	287.25
12.5 N	280.11	291.77	295.40	273.76	278.57	296.63	301.13	311.06	313.51	314.28	312.75	308.77	311.41	308.63	310.66	311.56	312.79	321.20	306.59	292.24
10.0 N	297.14	300.75	297.51	276.54	276.94	292.18	291.39	292.55	300.25	309.24	310.09	307.63	311.57	310.58	311.60	312.78	310.05	315.27	316.97	310.87

July

	30.0 E	32.5 E	35.0 E	37.5 E	40.0 E	42.5 E	45.0 E	47.5 E	50.0 E	52.5 E	55.0 E	57.5 E	60.0 E	62.5 E	65.0 E	67.5 E	70.0 E	72.5 E	75.0 E	77.5 E
40.0 N	288.55	281.22	284.82	286.92	281.89	274.12	271.47	285.21	307.28	305.48	284.91	279.83	284.96	279.66	274.34	272.75	256.87	239.05	243.81	262.92
37.5 N	281.46	280.05	285.82	283.47	280.39	278.02	269.46	273.28	296.58	302.72	278.88	265.43	274.61	280.87	275.62	265.52	245.93	227.93	231.44	251.34
35.0 N	305.21	311.89	311.62	293.72	284.27	284.24	270.46	255.78	259.49	270.17	268.59	259.54	259.05	260.80	252.53	250.59	260.13	258.71	238.56	219.44
32.5 N	315.70	317.32	306.15	284.11	276.58	280.05	277.35	269.37	255.52	248.35	256.17	260.90	261.69	263.86	253.77	254.45	287.50	312.40	289.08	245.72
30.0 N	300.67	297.97	288.75	276.48	273.29	271.92	272.54	283.38	274.86	249.43	244.90	251.63	255.97	264.98	267.33	272.46	296.03	314.63	314.64	301.08
27.5 N	286.13	285.03	283.81	273.08	265.24	264.93	264.23	276.09	289.40	282.44	273.55	271.02	265.43	263.96	271.51	288.08	303.05	303.92	307.26	319.73
25.0 N	281.15	280.05	289.42	286.93	268.81	266.50	265.03	280.82	298.19	296.45	295.34	303.44	307.67	309.13	313.92	315.75	313.27	312.07	312.89	
22.5 N	280.03	273.82	285.30	298.70	278.02	258.99	264.01	267.02	270.69	282.60	283.93	290.88	314.49	327.97	327.99	324.94	320.19	318.83	318.62	316.85
20.0 N	278.43	273.48	275.76	294.86	296.62	271.00	264.15	273.86	272.95	278.52	292.98	307.98	320.55	320.20	318.60	322.86	327.56	325.60	316.71	316.67
17.5 N	280.95	286.65	287.71	296.95	319.39	297.12	264.13	270.58	280.99	292.50	312.33	322.62	324.30	322.16	324.19	324.79	325.94	326.59	316.94	314.10
15.0 N	292.54	303.36	293.29	305.99	301.81	279.78	294.33	311.65	318.35	322.85	318.39	316.77	317.69	319.27	324					

ECM 1991 - 2000 Time Delay 3° Elevation (ns)

Middle East

January

	30.0 E	32.5 E	35.0 E	37.5 E	40.0 E	42.5 E	45.0 E	47.5 E	50.0 E	52.5 E	55.0 E	57.5 E	60.0 E	62.5 E	65.0 E	67.5 E	70.0 E	72.5 E	75.0 E	77.5 E
40.0 N	124.52	120.41	120.82	121.56	118.79	115.56	116.33	122.97	130.33	130.48	126.48	126.76	128.92	126.98	125.57	125.35	116.88	106.06	106.74	115.64
37.5 N	123.93	121.96	122.95	123.06	123.43	123.30	119.70	118.79	124.97	128.45	123.97	120.84	124.68	128.37	127.51	122.45	111.01	99.90	99.91	108.88
35.0 N	128.16	129.41	129.64	126.23	126.42	129.03	123.91	115.45	114.62	120.57	123.94	120.57	118.70	119.95	115.57	111.11	113.34	111.84	102.15	93.06
32.5 N	129.28	129.62	127.50	122.30	122.44	126.74	127.90	125.66	118.94	114.91	119.89	122.51	122.13	124.10	117.10	110.30	120.35	130.46	121.84	103.79
30.0 N	127.68	126.43	124.45	121.86	122.91	124.43	125.51	130.13	127.07	115.20	113.53	117.27	119.28	124.72	123.66	118.01	121.83	127.59	127.68	123.35
27.5 N	125.09	124.56	125.09	122.39	120.93	122.62	122.13	125.83	129.99	126.74	124.10	123.87	120.25	118.21	118.95	121.11	123.31	121.63	121.66	125.99
25.0 N	124.70	124.41	127.96	126.91	121.39	122.72	123.73	121.83	126.10	129.59	128.63	128.48	128.69	127.05	125.74	126.11	125.53	123.04	121.94	121.79
22.5 N	124.94	122.83	126.54	129.72	124.67	120.17	122.81	123.04	123.54	126.46	125.36	124.68	127.51	129.09	129.08	127.85	125.20	122.95	123.65	124.12
20.0 N	124.87	123.05	123.91	128.93	128.90	121.38	121.20	126.32	124.65	124.70	126.62	127.11	127.38	126.51	126.48	127.34	127.89	125.21	121.42	123.71
17.5 N	122.82	124.00	124.69	127.50	131.53	124.81	116.93	122.23	122.69	123.39	126.64	127.62	127.87	127.19	127.09	126.78	127.89	127.26	121.87	123.00
15.0 N	119.88	123.12	124.53	121.38	127.18	126.05	120.19	124.85	126.69	127.41	127.84	126.65	126.65	126.40	127.29	126.50	126.61	128.19	124.77	124.92
12.5 N	119.36	122.58	124.21	117.18	122.12	128.43	128.19	129.47	128.25	127.66	127.42	126.92	127.63	126.62	127.11	127.28	127.14	128.60	125.78	123.51
10.0 N	121.34	123.06	123.85	117.73	119.67	125.33	124.64	124.98	125.86	127.26	127.40	126.93	127.81	127.58	127.71	127.84	127.42	128.24	128.01	127.17

April

	30.0 E	32.5 E	35.0 E	37.5 E	40.0 E	42.5 E	45.0 E	47.5 E	50.0 E	52.5 E	55.0 E	57.5 E	60.0 E	62.5 E	65.0 E	67.5 E	70.0 E	72.5 E	75.0 E	77.5 E
40.0 N	125.02	121.67	122.82	123.63	120.65	117.72	118.97	125.19	131.31	130.51	126.03	126.50	128.45	125.70	124.73	126.52	119.49	108.57	108.94	117.46
37.5 N	124.47	122.89	124.44	125.14	125.95	126.05	122.56	121.51	126.90	128.93	123.68	121.28	125.33	128.19	127.65	124.52	113.91	102.05	102.01	111.27
35.0 N	128.88	130.03	130.17	126.87	127.41	130.12	125.21	117.24	116.43	121.28	123.61	120.42	118.90	120.06	116.50	113.75	116.80	114.93	104.31	94.39
32.5 N	130.17	130.58	127.82	121.51	121.24	125.52	126.77	125.22	119.49	115.79	120.06	121.58	120.59	122.47	116.21	111.04	122.80	132.87	124.21	105.58
30.0 N	127.57	126.51	123.91	120.37	121.15	122.61	123.72	128.88	125.82	114.00	112.45	116.09	117.86	122.72	121.54	117.29	122.84	128.83	128.41	123.96
27.5 N	123.74	123.10	123.45	120.54	119.30	121.25	121.16	124.95	128.85	124.86	121.95	121.85	118.26	115.77	116.72	120.23	123.49	122.11	121.53	125.03
25.0 N	122.76	122.52	126.67	125.81	120.01	121.58	123.16	121.06	125.01	128.98	127.39	126.78	127.86	127.11	126.66	127.63	127.09	124.29	121.95	120.58
22.5 N	122.65	121.00	125.65	129.36	123.18	118.31	121.66	121.94	121.89	124.92	123.43	123.72	128.62	130.03	129.74	129.55	127.98	124.79	122.83	122.20
20.0 N	122.53	121.35	122.83	128.78	128.85	120.44	120.30	125.73	123.57	123.28	125.82	127.60	128.43	126.96	126.18	127.43	128.80	126.20	120.41	121.67
17.5 N	120.54	122.32	123.30	127.28	132.39	125.34	116.69	122.07	122.62	123.64	127.46	128.01	127.66	126.69	126.23	126.29	127.36	127.22	121.14	121.35
15.0 N	118.68	122.85	124.63	121.64	127.24	125.90	120.31	125.79	127.76	128.01	127.87	126.26	125.91	125.79	126.29	125.63	125.76	127.76	124.81	123.42
12.5 N	121.98	125.85	127.54	119.61	121.68	127.41	127.79	129.56	128.48	127.36	126.62	125.87	126.33	125.57	125.76	125.76	125.68	127.55	126.84	123.61
10.0 N	126.81	127.81	127.81	120.99	121.35	126.02	124.61	124.32	125.40	126.38	126.14	125.66	126.32	125.95	126.10	126.38	125.93	127.10	128.34	127.90

July

	30.0 E	32.5 E	35.0 E	37.5 E	40.0 E	42.5 E	45.0 E	47.5 E	50.0 E	52.5 E	55.0 E	57.5 E	60.0 E	62.5 E	65.0 E	67.5 E	70.0 E	72.5 E	75.0 E	77.5 E
40.0 N	124.22	121.60	122.93	123.60	122.02	119.75	118.77	123.27	129.92	129.23	123.07	122.25	124.54	121.76	119.69	120.61	114.86	107.30	110.05	118.48
37.5 N	120.76	120.41	122.86	122.16	121.63	121.80	118.67	119.65	127.68	129.63	121.38	116.73	121.19	123.83	121.92	118.67	110.38	102.22	104.99	114.85
35.0 N	125.93	127.76	128.92	124.94	122.86	123.89	118.81	112.75	114.62	119.56	119.26	115.05	114.75	115.83	112.25	111.57	116.06	114.94	106.48	98.51
32.5 N	126.90	127.53	127.06	122.01	120.37	122.29	121.54	119.05	113.91	111.15	115.42	117.27	116.84	118.01	113.24	112.31	124.48	131.86	125.03	109.32
30.0 N	125.49	125.08	123.67	120.64	120.38	119.96	119.54	124.05	121.16	110.20	108.95	112.42	114.01	118.26	118.89	119.32	126.04	129.92	130.32	128.56
27.5 N	123.02	122.66	122.81	119.35	116.99	117.51	116.70	120.92	125.80	123.00	119.99	119.22	116.39	115.31	117.76	123.04	127.28	126.88	127.64	131.49
25.0 N	122.57	121.64	124.95	124.37	118.35	118.18	118.73	116.93	122.37	127.88	126.90	126.19	127.94	128.19	128.16	129.24	129.87	129.72	129.65	129.63
22.5 N	122.89	119.80	123.63	128.08	121.34	114.54	117.55	118.29	118.81	122.84	122.22	123.30	129.09	130.76	130.82	130.98	130.69	131.14	131.62	131.30
20.0 N	122.33	119.93	120.01	126.13	126.95	118.74	117.27	121.79	120.27	121.46	125.35	128.31	130.47	130.03	130.12	131.57	132.92	133.18	131.33	131.62
17.5 N	122.55	124.47	124.36	126.46	133.71	127.95	115.94	119.17	122.10	125.07	130.22	131.71	131.72	131.57	132.59	133.11	133.43	133.95	131.74	131.11
15.0 N	125.75	129.04	130.86	125.49	129.73	129.05	121.21	126.98	131.15	131.81	132.09	130.61	130.67</td							

ECM 1991 - 2000 Time Delay 5° Elevation (ns)

Middle East

January

	30.0 E	32.5 E	35.0 E	37.5 E	40.0 E	42.5 E	45.0 E	47.5 E	50.0 E	52.5 E	55.0 E	57.5 E	60.0 E	62.5 E	65.0 E	67.5 E	70.0 E	72.5 E	75.0 E	77.5 E
40.0 N	86.33	83.72	84.03	84.53	82.73	80.49	80.96	85.31	89.55	89.54	87.34	87.54	88.82	87.69	86.87	86.91	81.62	74.06	74.58	80.77
37.5 N	85.94	84.70	85.32	85.34	85.57	85.52	83.20	82.59	86.63	88.68	85.93	83.90	86.37	88.55	88.09	85.11	77.55	69.58	69.79	76.44
35.0 N	88.24	88.86	89.02	87.15	87.26	88.79	85.92	80.44	79.91	83.88	85.97	83.78	82.61	83.52	80.67	77.54	79.27	78.41	71.57	64.95
32.5 N	88.74	88.92	87.95	84.89	84.95	87.50	88.15	86.95	82.78	80.06	83.38	84.99	84.69	85.99	81.58	76.82	83.67	89.67	84.88	72.78
30.0 N	88.00	87.35	86.20	84.59	85.24	86.15	86.76	89.18	87.75	80.40	79.26	81.73	82.96	86.32	85.69	82.08	84.56	87.88	87.97	85.67
27.5 N	86.55	86.26	86.55	84.95	84.04	85.09	84.81	87.00	89.03	87.48	86.02	85.93	83.75	82.43	82.87	84.19	85.53	84.47	84.45	86.96
25.0 N	86.27	86.13	87.97	87.49	84.37	85.14	85.76	84.66	87.12	88.67	88.22	88.18	88.32	87.58	86.91	87.07	86.73	85.30	84.65	84.55
22.5 N	86.42	85.24	87.29	88.66	86.36	83.64	85.21	85.34	85.70	87.30	86.74	86.40	87.61	88.14	88.13	87.72	86.55	85.28	85.65	85.91
20.0 N	86.36	85.38	85.94	88.19	88.23	84.48	84.23	87.13	86.24	86.29	87.22	87.34	87.32	86.94	86.91	87.26	87.57	86.51	84.41	85.68
17.5 N	85.19	85.88	86.30	87.56	88.82	86.43	81.74	84.91	85.26	85.69	87.02	87.23	87.20	86.98	86.94	86.85	87.24	84.83	85.39	
15.0 N	83.43	85.34	86.16	84.56	87.40	86.92	83.89	86.31	87.05	87.20	87.18	86.74	86.72	86.64	86.85	86.65	86.68	87.35	86.32	86.34
12.5 N	83.10	85.01	85.95	81.87	84.83	87.79	87.61	87.90	87.35	87.05	86.89	86.76	86.92	86.71	86.81	86.84	86.80	87.28	86.72	85.74
10.0 N	84.32	85.28	85.72	82.16	83.37	86.51	86.23	86.36	86.65	87.05	87.02	86.93	87.16	87.19	87.22	87.25	87.16	87.37	87.53	87.36

April

	30.0 E	32.5 E	35.0 E	37.5 E	40.0 E	42.5 E	45.0 E	47.5 E	50.0 E	52.5 E	55.0 E	57.5 E	60.0 E	62.5 E	65.0 E	67.5 E	70.0 E	72.5 E	75.0 E	77.5 E
40.0 N	86.65	84.57	85.35	85.91	84.00	82.03	82.81	86.74	90.02	89.57	87.15	87.48	88.64	87.02	86.44	87.66	83.42	75.92	76.19	82.04
37.5 N	86.33	85.36	86.30	86.66	87.14	87.23	85.06	84.41	87.84	89.00	85.83	84.29	86.85	88.50	88.21	86.46	79.61	71.15	71.33	78.17
35.0 N	88.55	89.09	89.27	87.58	87.89	89.40	86.77	81.74	81.25	84.44	85.88	83.81	82.87	83.72	81.39	79.46	81.69	80.59	73.22	65.93
32.5 N	89.13	89.36	88.23	84.54	84.36	86.96	87.67	86.78	83.22	80.76	83.63	84.56	83.87	85.14	81.08	77.40	85.35	90.76	86.43	74.12
30.0 N	88.11	87.56	86.03	83.78	84.27	85.17	85.83	88.79	87.17	79.65	78.59	81.05	82.16	85.25	84.51	81.73	85.35	88.63	88.43	86.12
27.5 N	85.87	85.50	85.69	83.88	83.09	84.36	84.30	86.61	88.75	86.55	84.79	84.80	82.57	80.97	81.60	83.83	85.79	84.93	84.52	86.53
25.0 N	85.18	85.06	87.44	87.01	83.56	84.53	85.51	84.23	86.61	88.68	87.83	87.52	88.09	87.75	87.54	87.94	87.66	86.17	84.76	83.88
22.5 N	85.11	84.13	86.89	88.76	85.57	82.51	84.59	84.74	84.76	86.58	85.77	86.00	88.07	87.81	87.48	87.77	87.82	86.48	85.27	84.85
20.0 N	85.01	84.35	85.33	88.32	88.42	83.94	83.71	86.91	85.69	85.58	87.02	87.72	87.39	86.75	86.52	86.60	87.34	87.13	83.89	84.51
17.5 N	83.81	84.91	85.55	87.53	89.28	86.76	81.58	84.89	85.32	85.95	87.49	87.06	86.48	86.38	86.31	86.11	86.25	87.16	84.51	84.47
15.0 N	82.72	85.22	86.24	84.71	87.56	86.97	83.96	86.85	87.49	87.22	86.70	86.24	86.08	85.97	85.85	85.70	85.60	86.46	86.31	85.66
12.5 N	84.77	86.86	87.75	83.43	84.61	87.54	87.62	87.99	87.19	86.42	86.06	85.97	85.92	85.77	85.66	85.56	85.43	85.72	86.90	85.89
10.0 N	87.37	87.86	87.89	84.28	84.45	86.95	86.31	86.19	86.53	86.39	86.08	86.00	85.93	85.81	85.83	85.94	86.07	86.35	87.08	87.54

July

	30.0 E	32.5 E	35.0 E	37.5 E	40.0 E	42.5 E	45.0 E	47.5 E	50.0 E	52.5 E	55.0 E	57.5 E	60.0 E	62.5 E	65.0 E	67.5 E	70.0 E	72.5 E	75.0 E	77.5 E
40.0 N	86.18	84.63	85.44	85.79	84.81	83.29	82.56	85.35	88.71	88.38	85.18	84.68	86.10	84.40	83.10	83.80	80.20	74.98	76.88	82.50
37.5 N	84.12	83.90	85.27	84.71	84.31	84.41	82.41	83.04	87.65	88.67	84.17	81.16	84.04	85.57	84.42	82.52	77.16	71.43	73.47	80.31
35.0 N	86.04	86.60	87.27	85.87	84.83	85.49	82.62	78.79	80.12	83.28	82.99	80.20	80.04	80.78	78.44	77.96	81.08	80.51	74.82	69.11
32.5 N	85.63	85.85	86.59	84.55	83.53	84.58	84.20	82.76	79.52	77.68	80.52	81.62	81.28	82.08	79.01	78.40	86.01	89.34	86.52	76.80
30.0 N	86.06	85.98	85.47	83.83	83.58	83.27	82.98	85.61	84.09	77.12	76.30	78.61	79.56	82.20	82.59	82.96	86.79	88.29	88.54	88.29
27.5 N	85.16	84.99	85.04	83.04	81.53	81.83	81.28	83.87	86.51	85.09	83.36	82.96	81.32	80.70	82.24	85.26	87.41	87.39	87.79	87.27
25.0 N	84.88	84.37	86.08	85.77	82.36	82.23	82.57	81.45	84.76	87.47	86.99	86.64	87.39	87.45	87.53	88.03	88.47	88.76	88.93	88.99
22.5 N	85.10	83.30	85.51	87.71	84.26	79.98	81.89	82.33	82.70	85.18	84.88	85.49	87.98	87.96	88.15	88.76	89.22	89.67	89.97	89.89
20.0 N	84.85	83.46	85.58	86.94	87.37	82.80	81.76	84.53	83.63	84.44	86.69	88.04	88.72	88.78	89.19	89.87	90.36	90.73	90.13	90.21
17.5 N	85.09	86.22	86.19	87.28	90.51	88.12	81.08	83.11	85.02	86.74	89.08	89.47	89.43	89.76	90.43	90.94	91.14	91.31	90.51	90.11
15.0 N	87.05	88.65	89.50	87.00	88.94	88.73	84.58	87.68	89.57	89.81	89.72	89.35	89.53	90.05	90.77	91.12	91.06	91.43	90.99	90.12
12.5 N	88.97	89.50	90.50	86.41	86.80	89.07	88.58	89.54	89.49	89.36	89.32	89.11	89.66	90.06	90.38	90.86	90.97	91.20	90.80	89.10
10.0 N	90.44	89.67	89.30	85.47	86.48	88.31	86.75	85.83	86.82	88.66	89.16	88.98	89.36	89.73	90.00	90.27	90.22	90.42	90.67	90.18

October

| | **30.0 E** | **32.5 E** | **35.0 E** | **37.5 E** | **40.0 E** | **42.5 E** | **45.0 E** | **47.5 E** | **50.0 E** |
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ECM 1991 - 2000 Time Delay 0° Elevation (ns)

Amazon Rainforest

January

	82.5 W	80.0 W	77.5 W	75.0 W	72.5 W	70.0 W	67.5 W	65.0 W	62.5 W	60.0 W	57.5 W	55.0 W	52.5 W	50.0 W	47.5 W	45.0 W	42.5 W	40.0 W	37.5 W	35.0 W
12.5 N	317.61	315.29	312.89	314.83	313.70	314.55	314.70	314.76	314.83	313.50	313.53	315.00	316.54	315.67	314.79	316.88	317.00	315.08	315.93	316.00
10.0 N	314.75	312.48	318.20	312.41	301.16	301.71	304.81	309.82	315.00	317.80	317.25	314.10	315.21	318.06	316.88	315.68	317.76	317.38	316.76	317.23
7.5 N	311.10	314.22	319.31	301.20	294.38	305.24	305.01	302.87	306.60	314.16	319.31	319.78	318.35	316.58	319.16	318.56	317.66	319.24	318.67	318.20
5.0 N	313.92	321.43	312.17	289.19	297.23	317.11	311.27	299.19	297.96	308.10	314.31	317.12	322.37	318.89	318.99	320.91	319.52	320.16	319.35	319.88
2.5 N	317.07	317.40	303.32	300.79	313.49	322.07	316.83	310.49	307.38	313.43	316.64	311.72	318.89	322.78	319.96	320.06	320.56	321.72	319.96	320.81
0.0 N	320.43	304.00	295.50	316.52	320.39	318.37	318.93	321.72	322.77	317.94	319.85	317.77	320.14	325.04	323.59	323.01	320.88	321.34	320.50	319.29
2.5 S	319.57	297.08	298.36	327.15	319.75	321.80	324.34	317.98	326.95	324.53	323.01	324.16	324.18	325.46	323.85	325.76	322.19	320.54	322.36	320.21
5.0 S	317.81	297.35	297.77	328.21	319.98	321.05	331.27	321.88	324.77	326.38	326.36	324.24	322.20	324.84	322.15	324.20	322.76	316.92	317.35	319.56
7.5 S	320.31	303.66	281.10	309.84	325.67	313.51	320.83	328.82	327.60	322.23	323.35	322.35	319.63	322.93	320.97	321.12	319.84	310.80	308.45	315.31
10.0 S	317.00	316.44	278.29	287.55	327.90	327.47	317.36	318.07	322.85	324.43	320.81	319.54	321.74	322.61	319.20	316.73	313.41	309.97	312.82	317.08
12.5 S	305.95	321.94	297.95	266.95	274.40	301.37	322.67	318.41	312.44	320.48	318.99	317.03	323.38	321.43	315.50	311.90	306.13	309.52	319.05	318.31
15.0 S	301.23	311.95	316.98	284.04	248.98	252.96	294.85	323.50	315.57	314.65	320.17	316.95	316.91	314.11	311.56	311.97	306.59	310.43	319.22	315.98
17.5 S	306.00	299.82	311.56	317.01	298.80	258.76	253.44	291.71	311.12	312.45	322.59	317.51	312.46	313.24	310.74	310.86	309.73	314.47	319.69	315.87

April

	82.5 W	80.0 W	77.5 W	75.0 W	72.5 W	70.0 W	67.5 W	65.0 W	62.5 W	60.0 W	57.5 W	55.0 W	52.5 W	50.0 W	47.5 W	45.0 W	42.5 W	40.0 W	37.5 W	35.0 W
12.5 N	317.77	316.91	313.71	316.25	314.47	314.36	314.49	314.65	315.97	315.08	313.88	314.91	316.03	314.37	312.89	314.13	313.69	311.31	311.82	311.82
10.0 N	316.50	314.39	320.61	316.90	306.55	306.77	306.69	307.31	313.61	319.51	318.31	313.84	314.43	316.56	315.04	313.37	314.71	313.44	312.44	312.88
7.5 N	313.40	317.03	321.99	304.83	301.21	315.97	313.92	305.00	305.31	314.39	320.43	320.44	318.53	315.99	317.87	316.72	315.23	315.97	315.08	314.83
5.0 N	318.20	326.00	315.11	291.56	301.45	323.76	318.72	305.23	301.50	310.60	317.10	319.31	323.34	319.24	318.86	319.86	318.05	318.37	317.19	317.94
2.5 N	322.67	322.21	306.48	303.96	317.45	325.07	319.55	315.09	313.30	318.72	321.61	315.75	320.65	323.17	320.12	319.69	319.93	321.09	319.18	320.44
0.0 N	325.50	307.99	298.02	319.07	323.72	321.50	321.47	324.58	326.32	321.16	323.38	321.74	322.41	325.71	323.85	323.08	320.70	320.97	320.29	319.56
2.5 S	324.05	300.28	300.37	329.08	321.74	324.28	326.89	319.87	328.62	325.70	324.35	326.04	325.47	326.18	324.26	326.28	322.80	321.01	323.12	320.58
5.0 S	321.62	299.42	298.65	329.21	321.30	322.39	332.71	323.04	325.67	326.64	326.31	324.16	322.01	324.73	321.97	324.29	322.91	318.21	320.50	321.48
7.5 S	323.31	304.76	280.36	308.93	325.40	313.18	320.26	328.12	326.82	321.29	322.20	321.17	318.56	321.97	320.15	320.21	318.34	311.80	313.14	318.80
10.0 S	319.20	316.62	276.51	285.72	326.64	326.11	316.03	316.54	320.95	322.60	319.10	317.62	319.95	321.00	317.40	314.21	311.01	311.05	316.45	319.60
12.5 S	308.14	323.35	296.06	264.37	272.06	298.94	321.12	317.00	309.73	317.51	316.47	314.32	320.82	319.30	312.63	307.83	304.00	311.69	321.26	319.30
15.0 S	303.05	313.35	316.38	281.97	245.98	249.37	291.22	320.88	312.21	310.49	316.60	313.84	313.77	311.36	308.28	307.07	303.79	312.27	321.06	317.00
17.5 S	307.36	301.24	311.91	316.86	296.81	252.82	246.78	287.17	308.03	307.79	317.53	313.70	308.93	309.85	307.35	306.03	305.80	314.10	320.26	316.56

July

	82.5 W	80.0 W	77.5 W	75.0 W	72.5 W	70.0 W	67.5 W	65.0 W	62.5 W	60.0 W	57.5 W	55.0 W	52.5 W	50.0 W	47.5 W	45.0 W	42.5 W	40.0 W	37.5 W	35.0 W
12.5 N	324.18	321.93	319.81	321.84	319.64	320.32	319.49	318.28	319.04	317.96	317.62	318.62	319.26	317.78	316.23	317.80	318.19	316.72	317.96	318.58
10.0 N	322.42	319.85	326.75	322.12	311.36	314.44	316.68	317.35	320.38	321.92	320.43	316.96	317.52	320.02	319.03	317.83	319.81	319.51	319.11	320.17
7.5 N	318.96	321.69	325.30	306.00	301.37	317.82	319.24	313.84	313.67	318.28	322.39	322.39	320.52	318.15	320.07	319.29	318.20	319.60	318.97	318.84
5.0 N	319.82	327.72	315.50	290.71	300.36	323.49	318.35	306.64	305.28	314.02	318.78	319.17	322.90	318.57	317.79	319.74	317.98	318.15	316.89	317.18
2.5 N	321.53	320.60	303.40	301.08	315.52	324.36	318.09	313.16	312.41	318.45	320.75	313.39	318.55	321.01	317.48	317.75	317.63	318.15	315.93	316.65
0.0 N	322.86	303.26	291.86	314.80	320.25	318.40	318.30	321.56	323.42	317.82	319.94	317.83	318.73	321.90	319.69	319.32	317.89	318.73	317.24	315.27
2.5 S	318.79	293.48	293.85	324.87	317.79	320.65	322.65	314.72	323.96	320.88	319.46	321.38	320.93	321.65	319.69	320.56	316.79	315.81	318.45	317.12
5.0 S	314.64	291.68	292.24	323.59	313.51	316.40	327.78	316.73	319.08	320.22	319.85	318.24	316.30	318.14	314.03	312.38	308.16	305.03	311.50	317.77
7.5 S	316.17	297.16	274.72	301.99	314.49	301.71	310.47	318.41	316.20	309.90	310.03	308.37	304.97	306.57	302.84	300.87	299.99	298.56	304.88	314.32
10.0 S	312.96	309.75	269.14	279.19	318.63	315.49	303.24	302.24	304.74	304.96	300.48	296.84	297.15	297.26	294.36	294.61	297.94	303.90	311.55	315.07
12.5 S	303.16	316.08	286.94	255.56	265.57	292.74	312.24	303.92	292.18	296.62	294.79	291.72	296.15	294.59	2					

ECM 1991 - 2000 Time Delay 3° Elevation (ns)

Amazon Rainforest

January

	82.5 W	80.0 W	77.5 W	75.0 W	72.5 W	70.0 W	67.5 W	65.0 W	62.5 W	60.0 W	57.5 W	55.0 W	52.5 W	50.0 W	47.5 W	45.0 W	42.5 W	40.0 W	37.5 W	35.0 W
12.5 N	128.75	128.00	127.56	128.22	128.31	128.75	128.68	128.48	128.15	128.42	129.01	129.58	129.61	129.61	130.32	130.50	130.13	130.46	130.56	
10.0 N	128.14	127.36	128.52	128.30	125.99	126.23	126.84	128.04	128.96	129.35	129.36	128.90	129.44	130.28	130.15	130.01	130.65	130.63	130.53	130.73
7.5 N	127.46	127.86	129.54	126.30	124.79	127.61	127.21	126.73	127.60	129.24	130.25	130.40	130.29	130.00	130.72	130.68	130.53	130.99	130.90	130.87
5.0 N	128.07	129.66	129.09	123.22	125.48	130.21	128.74	125.60	125.26	127.98	129.47	130.19	131.45	130.65	130.80	131.33	131.00	131.20	131.06	131.20
2.5 N	128.98	129.88	127.10	126.65	129.71	130.95	129.99	128.72	127.94	129.61	130.36	128.99	130.92	131.71	131.12	131.25	131.36	131.62	131.22	131.35
0.0 N	130.03	127.05	124.92	130.73	130.97	130.40	130.64	131.32	131.74	130.82	131.42	130.88	131.47	132.55	132.19	132.06	131.56	131.61	131.30	130.93
2.5 S	130.24	125.41	126.83	132.98	131.03	131.48	132.05	130.76	132.96	132.63	132.43	132.74	132.75	133.03	132.59	132.91	132.09	131.65	131.79	131.06
5.0 S	130.03	125.83	126.10	133.81	131.48	131.75	133.77	132.07	133.06	133.59	133.70	133.26	132.74	133.37	132.57	132.96	132.64	131.21	131.04	130.99
7.5 S	130.25	127.88	121.14	130.08	133.12	129.73	132.27	134.27	134.14	132.93	133.43	133.24	132.38	133.18	132.53	132.50	132.22	129.78	128.89	130.02
10.0 S	129.17	130.92	120.47	124.31	134.86	133.82	131.29	131.73	133.17	133.71	132.87	132.56	133.01	133.10	132.16	131.57	130.70	129.56	129.82	130.03
12.5 S	126.30	130.76	126.67	116.93	120.01	128.67	133.26	131.26	129.74	132.41	132.09	131.58	133.37	132.84	131.27	130.45	128.73	129.22	130.61	129.67
15.0 S	125.23	127.99	130.71	122.92	109.63	110.99	126.96	133.38	130.36	130.22	131.83	131.13	131.43	130.75	130.11	130.56	128.80	129.26	130.33	129.04
17.5 S	126.66	124.88	128.32	131.25	128.52	115.20	111.87	126.03	129.86	128.96	131.64	130.75	129.75	130.32	129.81	130.22	129.54	130.07	130.39	129.20

April

	82.5 W	80.0 W	77.5 W	75.0 W	72.5 W	70.0 W	67.5 W	65.0 W	62.5 W	60.0 W	57.5 W	55.0 W	52.5 W	50.0 W	47.5 W	45.0 W	42.5 W	40.0 W	37.5 W	35.0 W
12.5 N	128.48	127.76	127.25	127.96	127.98	128.27	128.38	128.48	128.72	128.49	128.40	128.79	129.10	128.75	128.45	128.76	128.63	128.03	128.16	128.20
10.0 N	128.74	127.85	129.03	129.14	127.30	127.49	127.30	127.42	128.77	129.75	129.42	128.54	128.76	129.18	128.83	128.44	128.69	128.33	128.05	128.18
7.5 N	128.55	129.22	130.90	127.48	126.58	130.39	129.69	127.50	127.47	129.51	130.51	130.31	129.93	129.27	129.61	129.33	128.94	129.04	128.77	128.69
5.0 N	130.05	131.87	130.65	124.17	126.87	132.24	131.01	127.58	126.56	129.01	130.42	130.71	131.45	130.41	130.26	130.40	129.92	129.91	129.54	129.64
2.5 N	131.64	132.22	128.63	128.14	131.56	132.69	131.43	130.53	130.11	131.48	131.97	130.25	131.38	131.68	130.88	130.69	130.65	130.86	130.36	130.56
0.0 N	132.67	128.95	126.18	132.35	132.87	132.10	132.15	132.88	133.29	132.02	132.53	132.07	132.14	132.62	131.99	131.67	131.09	131.10	130.89	130.69
2.5 S	132.52	126.89	126.94	134.70	132.41	132.97	133.59	131.82	133.87	133.15	132.86	133.25	133.08	133.12	132.44	132.62	131.86	131.39	131.69	131.04
5.0 S	131.71	126.70	126.65	134.94	132.36	132.62	134.86	132.75	133.46	133.58	133.51	133.05	132.46	133.10	132.19	132.55	132.25	131.09	131.41	131.28
7.5 S	131.14	128.14	120.79	129.88	133.07	129.44	131.98	133.90	133.60	132.21	132.57	132.39	131.59	132.44	131.87	131.86	131.41	129.54	129.65	130.58
10.0 S	129.32	130.46	119.63	123.60	134.15	132.75	130.29	130.70	131.94	132.34	131.58	131.25	131.76	131.96	131.14	130.46	129.55	129.37	130.37	130.47
12.5 S	126.52	130.06	125.70	115.97	119.19	127.59	132.23	130.28	128.44	130.79	130.52	129.96	131.68	131.42	129.91	128.83	127.58	129.44	131.09	130.13
15.0 S	125.62	127.89	129.85	122.00	108.63	109.79	125.80	132.46	129.17	128.67	130.13	129.44	129.72	129.32	128.74	128.78	127.57	129.52	130.90	129.66
17.5 S	127.25	125.31	127.96	130.33	127.54	113.15	109.46	124.70	129.06	127.67	130.04	129.15	128.20	128.53	128.51	128.11	129.86	130.71	129.66	

July

	82.5 W	80.0 W	77.5 W	75.0 W	72.5 W	70.0 W	67.5 W	65.0 W	62.5 W	60.0 W	57.5 W	55.0 W	52.5 W	50.0 W	47.5 W	45.0 W	42.5 W	40.0 W	37.5 W	35.0 W
12.5 N	132.06	131.10	130.51	131.02	130.65	130.88	130.53	130.09	130.03	129.65	129.66	129.95	129.63	129.32	129.73	129.90	129.68	130.06	130.26	
10.0 N	132.18	131.14	132.59	131.96	129.22	130.18	130.54	130.60	131.15	131.17	130.74	129.93	130.11	130.67	130.47	130.25	130.81	130.85	130.86	131.19
7.5 N	131.39	131.91	133.28	128.17	126.77	131.58	131.62	130.16	130.12	131.15	131.84	131.60	131.17	130.60	131.06	130.89	130.68	131.12	131.03	131.08
5.0 N	131.33	133.42	131.36	124.11	126.78	133.13	131.41	127.87	127.50	130.14	131.28	131.16	132.01	130.84	130.60	131.09	130.65	130.76	130.39	130.42
2.5 N	131.59	132.28	127.86	127.39	131.34	131.35	131.35	130.00	129.78	131.45	131.88	129.56	131.01	131.39	130.41	130.50	130.37	130.49	129.82	129.80
0.0 N	131.85	127.52	124.39	131.28	132.07	131.26	131.21	132.10	132.49	130.90	131.52	130.82	130.87	131.34	130.73	130.74	130.28	130.37	129.84	129.14
2.5 S	130.85	124.37	124.79	133.29	129.64	130.56	132.98	130.11	130.69	130.95	131.08	130.86	130.32	130.79	129.77	129.54	128.49	127.50	128.88	129.83
7.5 S	129.15	125.83	118.63	127.77	129.93	125.80	128.88	130.83	130.19	128.59	128.93	128.71	127.83	128.42	127.35	126.86	126.55	125.79	127.04	128.80
10.0 S	127.98	128.99	117.22	121.64	132.77	130.44	126.75	126.81	127.83	128.07	126.99	126.11	126.27	126.38	125.61	125.76	126.29	127.19	128.42	128.59
12.5 S	125.48	129.65	123.68	113.03	117.26	126.47	130.58	127.39	124.35	126.36	125.93	125.00	126.56	126.16	124.98	125.22	125.36	127.25	128.75	128.09
15.0 S	124.87	127.62	129.30	119.10	104.89	107.07	124.11	131.20	126.90	124.93	126.13	125.51	125.47	124.78	124.58	125.59	125.42			

ECM 1991 - 2000 Time Delay 5° Elevation (ns)

Amazon Rainforest

January

	82.5 W	80.0 W	77.5 W	75.0 W	72.5 W	70.0 W	67.5 W	65.0 W	62.5 W	60.0 W	57.5 W	55.0 W	52.5 W	50.0 W	47.5 W	45.0 W	42.5 W	40.0 W	37.5 W	35.0 W
12.5 N	87.43	87.20	87.14	87.35	87.52	87.69	87.74	87.76	87.63	87.56	87.79	88.09	88.38	88.57	88.71	89.04	89.17	89.12	89.27	89.32
10.0 N	87.29	87.06	87.12	87.54	86.84	86.89	87.15	87.65	87.90	87.99	88.18	88.27	88.57	88.89	88.97	89.03	89.28	89.32	89.31	89.39
7.5 N	87.34	87.29	87.67	87.00	86.39	87.49	87.34	87.16	87.55	88.25	88.64	88.82	88.96	88.97	89.20	89.27	89.29	89.45	89.46	89.47
5.0 N	87.53	87.73	88.23	85.85	86.78	88.47	88.09	86.68	86.56	87.86	88.61	89.03	89.41	89.30	89.39	89.57	89.52	89.59	89.60	89.60
2.5 N	87.83	88.36	87.48	87.31	88.63	88.80	88.72	88.25	87.92	88.66	89.02	88.70	89.51	89.77	89.68	89.73	89.75	89.79	89.69	89.63
0.0 N	88.08	87.48	86.66	89.11	89.27	89.19	89.24	89.37	89.60	89.57	89.74	89.61	89.93	90.29	90.22	90.10	89.95	89.88	89.72	89.52
2.5 S	88.24	86.77	87.11	89.79	89.71	89.72	89.91	89.82	90.35	90.51	90.48	90.53	90.60	90.70	90.60	90.51	90.23	89.99	89.79	89.47
5.0 S	88.29	86.97	87.30	90.22	90.02	90.09	90.35	90.54	90.90	91.15	91.19	91.07	90.89	91.01	90.78	90.76	90.54	89.95	89.65	89.37
7.5 S	88.21	87.90	84.89	89.19	90.48	89.53	90.63	91.32	91.44	91.15	91.33	91.22	90.85	91.04	90.77	90.62	90.38	89.31	88.85	89.03
10.0 S	87.83	88.96	84.38	86.46	90.82	90.64	90.05	90.43	91.09	91.32	91.03	90.90	91.03	90.96	90.50	90.12	89.63	89.04	88.98	88.74
12.5 S	86.76	88.21	87.42	81.98	83.93	88.76	90.41	89.71	89.27	90.54	90.48	90.31	91.02	90.77	90.04	89.56	88.73	88.80	88.89	88.30
15.0 S	86.22	87.27	88.57	85.80	77.13	78.06	87.87	90.08	89.10	89.26	89.99	89.88	90.05	89.72	89.39	89.52	88.71	88.79	88.69	88.13
17.5 S	86.67	86.06	87.40	88.87	88.34	80.86	78.57	87.39	88.74	88.46	89.38	89.46	89.12	89.31	89.11	89.32	89.01	89.05	88.71	88.29

April

	82.5 W	80.0 W	77.5 W	75.0 W	72.5 W	70.0 W	67.5 W	65.0 W	62.5 W	60.0 W	57.5 W	55.0 W	52.5 W	50.0 W	47.5 W	45.0 W	42.5 W	40.0 W	37.5 W	35.0 W
12.5 N	87.18	86.81	88.85	87.04	87.23	87.38	87.45	87.59	87.70	87.70	87.78	87.93	88.00	87.93	87.85	87.91	87.82	87.61	87.60	87.61
10.0 N	87.63	87.33	87.39	87.85	87.56	87.62	87.50	87.50	87.92	88.12	88.12	87.99	88.05	88.07	87.96	87.84	87.80	87.64	87.51	87.52
7.5 N	88.13	88.27	88.71	87.78	87.33	88.88	88.62	87.71	87.67	88.52	88.79	88.70	88.63	88.39	88.35	88.26	88.11	88.04	87.91	87.84
5.0 N	88.88	89.27	89.40	86.56	87.70	89.74	89.44	87.85	87.39	88.60	89.24	89.32	89.35	89.08	88.87	88.72	88.63	88.47	88.41	88.41
2.5 N	89.66	90.00	88.56	88.34	89.92	90.18	89.86	89.47	89.28	89.85	90.00	89.45	89.80	89.76	89.48	89.28	89.20	89.18	89.02	88.98
0.0 N	89.99	88.80	87.57	90.34	90.65	90.38	90.37	90.55	90.69	90.40	90.43	90.30	90.33	90.33	90.04	89.77	89.58	89.50	89.41	89.32
2.5 S	89.87	87.77	87.91	91.18	90.76	90.81	91.04	90.60	91.03	90.91	90.77	90.84	90.81	90.74	90.45	90.21	89.99	89.77	89.68	89.50
5.0 S	89.46	87.55	87.71	91.16	90.67	90.74	91.21	91.03	91.13	91.05	90.91	90.70	90.81	90.48	90.39	90.21	89.76	89.66	89.50	89.50
7.5 S	88.74	88.03	84.64	89.11	90.44	89.28	90.43	91.07	91.04	90.61	90.68	90.58	90.26	90.48	90.25	90.14	89.86	89.05	89.03	89.21
10.0 S	87.78	88.54	83.82	85.98	90.27	89.77	89.26	89.64	90.15	90.24	90.02	89.91	90.08	90.10	89.75	89.37	88.89	88.80	89.13	88.95
12.5 S	86.77	87.54	86.77	81.39	83.41	88.01	89.58	88.91	88.37	89.35	89.29	89.12	89.74	89.67	89.08	88.51	87.90	88.75	89.16	88.73
15.0 S	86.44	87.04	87.84	85.20	76.54	77.32	87.18	89.45	88.32	88.26	88.76	88.63	88.80	88.67	88.44	88.42	87.89	88.78	89.04	88.65
17.5 S	87.11	86.32	87.08	87.98	87.59	79.58	76.99	86.61	88.24	87.73	88.40	88.30	88.03	88.33	88.23	88.23	88.09	88.84	88.95	88.66

July

	82.5 W	80.0 W	77.5 W	75.0 W	72.5 W	70.0 W	67.5 W	65.0 W	62.5 W	60.0 W	57.5 W	55.0 W	52.5 W	50.0 W	47.5 W	45.0 W	42.5 W	40.0 W	37.5 W	35.0 W
12.5 N	89.82	89.37	89.17	89.25	89.18	89.18	89.00	88.82	88.68	88.52	88.54	88.54	88.49	88.43	88.37	88.49	88.59	88.62	88.78	88.88
10.0 N	90.22	89.77	89.97	89.87	88.77	89.21	89.38	89.36	89.43	89.30	89.16	89.86	89.00	89.11	89.07	89.05	89.25	89.35	89.43	89.56
7.5 N	90.08	90.21	90.56	88.25	87.52	89.86	89.90	89.21	89.21	89.68	89.84	89.67	89.54	89.36	89.44	89.41	89.39	89.56	89.62	89.62
5.0 N	89.86	90.47	89.97	86.54	87.68	90.60	89.91	88.03	87.84	89.27	89.82	89.74	89.90	89.51	89.35	89.47	89.36	89.38	89.24	89.18
2.5 N	89.67	90.17	88.11	87.86	88.95	90.61	89.90	89.19	89.08	89.85	89.97	89.04	89.62	89.65	89.26	89.23	89.14	89.13	88.82	88.63
0.0 N	89.37	87.89	88.58	89.72	90.25	89.90	89.80	90.12	90.22	89.70	89.85	89.53	89.50	89.49	89.27	89.24	89.01	88.93	88.65	88.26
2.5 S	88.75	86.56	86.82	90.47	89.75	89.93	89.96	89.19	89.80	89.57	89.55	89.67	89.47	89.30	89.21	89.31	88.99	88.78	88.75	88.46
5.0 S	88.01	86.16	86.58	90.08	88.87	89.31	89.83	89.13	89.17	89.22	89.33	89.32	89.09	89.12	88.78	88.64	88.16	87.75	88.25	88.46
7.5 S	87.51	86.60	83.19	87.74	88.65	87.05	88.44	89.06	88.80	88.23	88.35	88.26	87.92	88.10	87.62	87.34	87.16	86.85	87.40	87.98
10.0 S	87.04	87.76	82.21	84.73	89.64	88.63	87.19	87.36	87.83	87.86	87.42	87.05	87.11	87.11	86.78	86.81	86.97	87.26	87.69	87.63
12.5 S	86.19	87.70	85.86	79.43	82.10	87.42	88.75	87.37	86.22	87.13	86.91	86.46	87.13	86.95	86.43	86.54	86.58	87.22	87.50	87.34
15.0 S	86.00	87.04	87.96	83.43	73.89	75.43	86.21	88.97	87.25	86.45	86.99	86.72	86.68	86.33	86.23	86.71	86.62	87.18	87.36	87.25
17.5 S	86.94	86.16	87.29	88.44	87.19	77.41	74.73	85.19	87.82	86.76	87.42	87.10	86.52	86.71	86.60	86.75	86.92	87.48	87.55	87.48

October

	82.5 W	**80.0 W**	**77.5 W**	**75.0 W**	**72.5 W**	**70.0 W**	**67.5 W**	**65.0 W**	**62.5 W**	**60.0 W**	**57.5 W**

ECM 1991 - 2000 Time Delay 0° Elevation (ns)

North East Asia

January

	105.0 E	107.5 E	110.0 E	112.5 E	115.0 E	117.5 E	120.0 E	122.5 E	125.0 E	127.5 E	130.0 E	132.5 E	135.0 E	137.5 E	140.0 E	142.5 E	145.0 E	147.5 E	150.0 E
55.0 N	289.40	284.01	277.01	274.10	275.35	277.45	279.20	281.71	284.28	284.44	282.17	280.93	283.55	288.89	293.16	293.67	291.65	290.41	290.92
52.5 N	285.26	284.38	278.52	277.36	280.76	282.42	281.99	284.19	288.94	290.97	288.22	284.68	284.35	287.45	291.30	292.72	291.40	290.15	290.6
50.0 N	276.35	275.91	273.17	276.89	283.17	283.62	281.25	283.44	288.45	290.26	288.83	287.23	285.75	285.05	286.95	290.13	291.42	290.96	290.74
47.5 N	271.52	271.62	272.37	278.08	282.63	281.80	281.92	287.20	291.38	290.46	289.73	290.96	289.64	286.66	287.02	289.67	290.41	289.70	289.63
45.0 N	270.77	274.38	278.28	279.34	277.02	276.57	283.00	291.85	293.16	288.14	286.60	288.92	288.65	287.17	288.54	289.94	289.30	289.59	290.92
42.5 N	272.10	273.44	275.96	273.80	270.97	274.78	284.45	291.06	287.85	281.52	282.52	288.78	291.23	290.51	290.37	289.00	287.97	290.39	292.33
40.0 N	270.09	269.52	269.43	271.92	278.49	287.05	292.83	293.64	289.26	284.73	287.94	295.69	297.12	293.34	291.64	291.43	291.91	293.85	294.05
37.5 N	261.62	268.18	270.27	277.22	288.41	295.04	295.64	295.15	293.74	291.05	292.38	296.64	294.17	287.83	288.55	293.72	295.98	296.00	295.43
35.0 N	253.11	268.77	275.52	284.62	292.99	294.48	295.16	296.34	295.32	292.63	291.53	293.44	292.39	288.78	291.27	296.81	298.34	298.22	298.35
32.5 N	266.28	276.40	276.98	288.94	296.73	294.66	297.24	299.76	298.52	297.96	296.00	295.27	296.88	297.29	298.84	300.40	300.20	300.94	301.2
30.0 N	286.41	286.77	281.91	294.41	297.61	291.31	294.68	299.31	299.78	302.06	301.38	299.76	301.01	301.25	301.49	301.68	301.46	302.19	301.92
27.5 N	276.48	283.67	289.53	296.48	292.95	289.41	296.09	302.88	303.24	303.07	302.34	302.29	303.10	302.19	302.56	303.33	303.77	304.76	304.55

April

	105.0 E	107.5 E	110.0 E	112.5 E	115.0 E	117.5 E	120.0 E	122.5 E	125.0 E	127.5 E	130.0 E	132.5 E	135.0 E	137.5 E	140.0 E	142.5 E	145.0 E	147.5 E	150.0 E
55.0 N	287.48	281.33	273.39	270.18	271.78	274.27	276.15	278.77	281.62	281.92	279.65	278.65	282.13	288.69	294.06	295.29	293.79	293.12	294.2
52.5 N	284.94	283.86	276.47	274.50	278.26	280.34	279.82	282.20	287.90	290.60	287.79	283.87	283.62	287.36	291.91	294.08	293.54	293.14	294.28
50.0 N	276.85	275.43	270.58	273.42	280.17	280.94	278.27	280.83	287.12	290.01	288.90	287.30	286.03	285.88	288.55	292.56	294.53	294.48	294.5
47.5 N	271.03	269.20	267.73	273.04	278.37	278.01	278.77	285.70	291.53	291.32	290.84	292.58	292.03	289.83	290.91	294.06	294.80	293.77	293.57
45.0 N	265.60	268.55	272.38	274.16	272.37	272.47	280.90	292.84	295.73	290.38	288.63	291.66	292.37	291.72	293.69	295.13	294.12	294.06	295.27
42.5 N	263.41	265.51	269.89	269.37	267.17	271.57	283.54	293.13	290.99	284.07	285.25	292.61	295.90	295.62	295.65	294.05	292.92	295.54	297.42
40.0 N	262.65	262.09	263.62	267.79	275.26	284.19	291.70	295.88	293.65	289.23	292.44	300.50	301.84	298.17	296.80	296.55	297.12	299.50	299.71
37.5 N	259.94	265.15	267.77	275.78	286.82	292.48	294.20	297.54	299.50	297.30	297.53	300.57	297.80	293.07	295.29	300.21	301.68	301.66	301.24
35.0 N	259.31	272.39	278.87	289.03	296.71	296.94	297.71	300.30	300.80	298.83	297.49	298.31	297.53	296.40	300.22	304.48	304.55	304.32	304.6
32.5 N	278.07	284.55	284.63	298.27	305.80	302.94	304.03	304.52	302.75	303.82	303.67	303.02	304.41	305.55	306.90	307.38	306.91	307.86	308.17
30.0 N	298.78	297.58	293.23	306.94	310.38	303.59	304.12	305.41	305.27	308.65	309.32	308.25	309.23	309.17	308.96	309.28	309.73	310.54	310.26
27.5 N	285.54	295.04	302.88	310.79	308.53	304.78	307.33	310.91	311.51	311.48	310.94	311.46	312.49	311.62	311.92	312.91	313.59	314.46	314.22

July

	105.0 E	107.5 E	110.0 E	112.5 E	115.0 E	117.5 E	120.0 E	122.5 E	125.0 E	127.5 E	130.0 E	132.5 E	135.0 E	137.5 E	140.0 E	142.5 E	145.0 E	147.5 E	150.0 E
55.0 N	302.57	295.54	287.68	286.11	289.70	292.87	294.45	297.16	300.58	300.93	297.82	295.71	297.87	302.50	305.31	304.38	301.81	300.93	302.51
52.5 N	302.90	301.18	291.97	290.06	295.40	297.87	296.33	298.75	305.96	309.87	307.01	302.44	301.07	302.62	304.21	303.96	302.37	301.70	302.88
50.0 N	292.93	289.87	282.37	284.68	292.30	293.48	291.27	295.34	303.71	307.90	307.40	306.26	304.80	302.74	302.27	303.60	304.09	303.20	302.63
47.5 N	279.51	276.60	275.01	281.38	287.56	288.23	291.57	301.79	309.55	309.60	309.03	310.88	309.95	306.04	304.62	305.54	304.86	302.82	301.82
45.0 N	267.82	272.06	277.95	281.74	281.24	283.64	296.46	312.30	315.70	308.79	305.53	307.42	307.26	305.84	306.73	306.86	304.86	304.72	304.72
42.5 N	266.03	270.35	277.00	279.03	279.48	286.79	301.80	313.17	310.45	302.08	301.93	307.81	310.43	310.55	310.51	308.03	305.92	307.66	309.06
40.0 N	270.17	271.65	276.11	285.09	296.89	306.72	313.11	316.44	313.48	308.39	310.74	317.22	317.64	314.49	313.66	313.16	312.74	314.17	314.11
37.5 N	273.34	281.61	288.33	300.98	314.59	317.92	315.75	317.40	318.93	316.34	315.78	317.43	314.38	310.74	313.94	318.73	319.07	317.84	317.39
35.0 N	275.00	292.43	303.14	315.52	323.18	321.13	319.10	319.86	319.36	317.16	315.55	315.51	314.85	315.06	319.34	323.00	322.08	320.95	320.89
32.5 N	294.84	304.44	306.94	312.15	328.23	324.91	325.36	324.95	322.01	322.14	321.83	320.74	321.77	323.46	324.33	323.51	322.33	322.73	322.69
30.0 N	318.65	317.55	312.93	326.37	328.61	321.22	322.69	324.94	323.47	324.22	324.25	323.50	324.46	324.45	323.41	322.46	322.06	322.18	321.93
27.5 N	305.91	311.38	317.68	325.75	322.50	318.44	322.01	326.03	325.16	322.96	321.88	322.50	323.00	321.78	321.51	321.94	322.10	322.36	322.25

October

	105.0 E	**107.5 E**	**110.0 E**	**112.5 E**	**115.0 E**	**117.5 E**	**120.0 E**	**122.5 E**	**125.0 E**	**127.5 E**	**130.0 E**	**132.5 E**	**135.0 E**	**137.5 E**	**140.0 E**	**142.5 E**	**145.0 E**	**147.5 E**	**150.0 E**

</tbl

ECM 1991 - 2000 Time Delay 3° Elevation (ns)

North East Asia

January

	105.0 E	107.5 E	110.0 E	112.5 E	115.0 E	117.5 E	120.0 E	122.5 E	125.0 E	127.5 E	130.0 E	132.5 E	135.0 E	137.5 E	140.0 E	142.5 E	145.0 E	147.5 E	150.0 E
55.0 N	125.26	122.89	120.11	119.06	119.63	120.34	120.77	121.51	122.37	122.31	121.30	120.73	121.64	123.53	124.86	124.76	123.85	123.42	123.8
52.5 N	124.44	123.93	121.29	120.73	122.05	122.44	121.82	122.36	124.06	124.69	123.50	122.04	121.83	122.89	124.14	124.46	123.81	123.32	123.6
50.0 N	121.31	120.68	119.17	120.56	122.97	122.79	121.39	121.92	123.61	124.03	123.35	122.79	122.24	121.84	122.41	123.51	123.90	123.68	123.63
47.5 N	119.77	119.09	118.94	121.25	123.04	122.24	121.71	123.42	124.77	124.11	123.76	124.38	123.84	122.49	122.51	123.44	123.57	123.18	123.16
45.0 N	119.34	120.58	122.04	122.30	121.01	120.32	122.38	125.53	125.78	123.59	122.89	123.70	123.30	122.53	123.16	123.72	123.26	123.26	123.76
42.5 N	119.92	120.42	121.55	120.20	118.38	119.43	122.88	125.15	123.74	121.11	121.38	123.57	124.16	123.80	123.90	123.32	122.73	123.64	124.34
40.0 N	120.06	119.16	118.80	119.45	121.67	124.44	126.05	126.05	124.39	122.55	123.55	126.22	126.53	125.15	124.64	124.40	124.32	125.01	125
37.5 N	117.40	119.22	119.16	121.44	125.33	127.08	126.72	126.41	126.04	125.00	125.23	126.62	125.64	123.23	123.56	125.28	125.75	125.64	125.38
35.0 N	113.36	119.30	121.16	124.15	126.54	126.38	126.38	126.67	126.24	125.27	124.75	125.43	125.06	123.57	124.38	126.11	126.29	126.18	126.2
32.5 N	118.77	121.55	120.77	125.21	127.50	126.29	127.16	127.72	126.97	126.79	126.03	125.71	126.26	126.20	126.54	126.85	126.59	126.81	126.86
30.0 N	126.79	124.88	122.08	126.72	127.51	124.91	126.01	127.07	126.74	127.46	127.18	126.59	126.97	126.85	126.79	126.78	126.63	126.85	126.71
27.5 N	121.74	123.03	124.70	127.07	125.60	124.08	126.04	127.54	127.08	126.96	126.75	126.75	127.04	126.63	126.69	126.90	126.99	127.33	127.21

April

	105.0 E	107.5 E	110.0 E	112.5 E	115.0 E	117.5 E	120.0 E	122.5 E	125.0 E	127.5 E	130.0 E	132.5 E	135.0 E	137.5 E	140.0 E	142.5 E	145.0 E	147.5 E	150.0 E
55.0 N	124.97	122.32	119.20	118.10	118.92	119.87	120.40	121.26	122.28	122.31	121.30	120.84	122.09	124.38	125.98	126.01	125.18	124.85	125.33
52.5 N	124.73	124.26	121.11	120.30	121.91	122.56	121.92	122.57	124.64	125.56	124.34	122.75	122.56	123.79	125.21	125.68	125.22	124.96	125.39
50.0 N	122.00	121.07	118.75	119.90	122.70	122.69	121.15	121.84	124.04	124.89	124.35	123.82	123.34	123.11	123.88	125.16	125.70	125.56	125.53
47.5 N	120.37	118.90	117.85	120.11	122.34	121.73	121.40	123.71	125.66	125.30	125.08	125.90	125.64	124.56	124.76	125.77	125.84	125.31	125.19
45.0 N	118.16	119.19	120.66	121.23	120.14	119.61	122.39	126.61	127.41	125.18	124.50	125.55	125.44	124.93	125.72	126.22	125.62	125.48	125.87
42.5 N	117.33	118.24	120.17	119.42	117.79	118.99	123.17	126.43	125.38	122.62	123.03	125.59	126.39	126.15	126.30	125.65	125.04	125.95	126.54
40.0 N	117.80	116.97	117.28	118.60	121.19	124.04	126.10	127.11	126.17	124.47	125.50	128.13	128.33	127.06	126.69	126.42	126.37	127.18	127.16
37.5 N	117.26	118.48	118.68	121.33	125.04	126.38	126.30	127.15	127.78	127.00	126.94	127.89	126.90	125.18	125.97	127.40	127.60	127.58	127.45
35.0 N	116.38	120.91	122.56	125.67	127.52	126.95	126.99	127.65	127.64	126.98	126.51	126.88	126.65	126.12	127.24	128.36	128.20	128.21	128.37
32.5 N	123.21	124.32	123.44	127.82	129.52	128.28	128.72	128.69	127.90	128.26	128.17	127.97	128.43	128.62	128.89	128.92	128.74	129.12	129.24
30.0 N	130.50	127.95	125.58	129.69	130.23	128.10	128.45	128.64	128.36	129.42	129.54	129.16	129.47	129.35	129.24	129.30	129.38	129.62	129.51
27.5 N	124.83	126.33	128.06	130.18	129.35	128.34	129.19	130.05	129.94	129.84	129.61	129.72	130.04	129.72	129.77	130.00	130.10	130.32	130.2

July

	105.0 E	107.5 E	110.0 E	112.5 E	115.0 E	117.5 E	120.0 E	122.5 E	125.0 E	127.5 E	130.0 E	132.5 E	135.0 E	137.5 E	140.0 E	142.5 E	145.0 E	147.5 E	150.0 E
55.0 N	128.98	126.54	124.05	123.79	125.16	126.10	126.34	126.97	127.89	127.91	126.96	126.39	127.09	128.34	128.91	128.39	127.51	127.25	127.81
52.5 N	129.73	129.17	126.07	125.56	127.45	128.03	127.09	127.44	129.25	130.09	129.16	127.93	127.65	128.10	128.46	128.29	127.80	127.63	128
50.0 N	127.37	125.96	123.02	123.90	126.61	126.64	125.32	126.15	128.25	128.98	128.64	128.53	128.37	127.86	127.71	128.10	128.26	128.03	127.92
47.5 N	123.46	121.58	120.60	123.18	125.49	125.09	125.37	127.95	129.66	129.22	129.07	129.89	129.77	128.62	128.24	128.56	128.36	127.81	127.62
45.0 N	118.97	120.46	122.65	123.90	123.22	123.33	126.83	130.83	131.19	129.14	128.42	128.99	128.71	128.19	128.63	128.79	128.21	128.33	128.33
42.5 N	118.12	119.86	122.41	122.51	121.85	123.74	127.96	130.62	129.48	127.13	127.24	128.79	129.18	129.19	129.43	128.78	128.12	128.72	129.2
40.0 N	120.02	119.95	121.16	123.95	127.42	129.70	130.62	130.92	130.00	128.66	129.32	130.93	130.86	130.08	130.06	129.90	129.70	130.22	130.25
37.5 N	121.45	123.58	124.85	128.18	131.41	131.47	130.32	130.52	130.85	130.24	130.19	130.75	129.99	128.98	129.95	131.17	131.19	130.99	130.96
35.0 N	121.10	126.56	128.85	131.46	132.50	131.43	130.81	130.83	130.52	130.07	129.94	130.23	130.18	131.26	132.06	132.08	131.83	131.73	131.8
32.5 N	127.73	129.29	128.96	132.64	133.76	132.63	132.64	132.12	131.08	131.20	131.33	131.26	131.62	132.01	132.13	131.87	131.66	131.91	131.92
30.0 N	135.23	132.63	130.51	134.33	134.47	132.28	132.41	132.26	131.40	131.54	131.66	131.52	131.76	131.78	131.57	131.39	131.33	131.39	131.31
27.5 N	130.52	130.46	131.97	134.17	133.04	131.68	132.27	132.47	131.71	131.18	130.99	131.01	131.04	130.83	130.88	131.05	131.06	131.09	131.08

October

	105.0 E	**107.5 E**	**110.0 E**	**112.5 E**	**115.0 E**	**117.5 E**	**120.0 E**	**122.5 E**	**125.0 E**	**127.5 E**	**130.0 E**	**132.5 E**	**135.0 E**	**137.5 E**	**140.0 E**	**142.5 E**	**145.0 E**	**147.5 E**	**150.0 E**

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ECM 1991 - 2000 Time Delay 5° Elevation (ns)

North East Asia

January

	105.0 E	107.5 E	110.0 E	112.5 E	115.0 E	117.5 E	120.0 E	122.5 E	125.0 E	127.5 E	130.0 E	132.5 E	135.0 E	137.5 E	140.0 E	142.5 E	145.0 E	147.5 E	150.0 E
55.0 N	86.53	85.03	83.23	82.54	82.91	83.34	83.56	84.01	84.55	84.49	83.82	83.43	84.00	85.16	85.95	85.87	85.31	85.05	85.3
52.5 N	86.10	85.70	83.95	83.58	84.44	84.65	84.19	84.49	85.55	85.91	85.15	84.22	84.08	84.75	85.50	85.67	85.26	84.96	85.15
50.0 N	84.18	83.70	82.62	83.52	85.07	84.89	83.93	84.26	85.32	85.53	85.06	84.71	84.36	84.08	84.43	85.11	85.32	85.16	85.13
47.5 N	83.20	82.66	82.50	84.00	85.13	84.55	84.15	85.23	86.03	85.56	85.30	85.67	85.33	84.46	84.48	85.06	85.12	84.87	84.86
45.0 N	82.89	83.65	84.56	84.70	83.84	83.34	84.63	86.56	86.66	85.27	84.82	85.32	85.04	84.52	84.91	85.24	84.94	84.93	85.23
42.5 N	83.24	83.59	84.34	83.43	82.18	82.86	85.06	86.43	85.52	83.80	83.95	85.31	85.61	85.35	85.41	85.05	84.67	85.23	85.64
40.0 N	83.47	82.83	82.58	82.98	84.37	86.08	86.99	86.95	85.94	84.75	85.34	86.88	87.00	86.19	85.89	85.75	85.69	86.10	86.08
37.5 N	81.85	82.94	82.82	84.28	86.70	87.67	87.41	87.19	86.94	86.28	86.38	87.18	86.62	85.17	85.36	86.36	86.60	86.52	86.36
35.0 N	79.11	83.01	84.14	86.00	87.41	87.29	87.26	87.38	87.11	86.52	86.19	86.57	86.33	85.44	85.90	86.84	86.92	86.84	86.85
32.5 N	82.77	84.40	83.84	86.62	87.90	87.18	87.63	87.89	87.46	87.34	86.90	86.70	86.95	86.88	87.03	87.17	87.04	87.14	87.15
30.0 N	87.51	86.28	84.61	87.39	87.79	86.36	86.98	87.50	87.28	87.56	87.38	87.08	87.24	87.15	87.09	87.08	87.03	87.13	87.07
27.5 N	84.47	85.19	86.17	87.45	86.69	85.87	86.93	87.55	87.26	87.15	87.05	87.06	87.18	86.99	87.00	87.09	87.15	87.32	87.28

April

	105.0 E	107.5 E	110.0 E	112.5 E	115.0 E	117.5 E	120.0 E	122.5 E	125.0 E	127.5 E	130.0 E	132.5 E	135.0 E	137.5 E	140.0 E	142.5 E	145.0 E	147.5 E	150.0 E
55.0 N	86.40	84.73	82.72	82.00	82.56	83.17	83.47	84.01	84.66	84.67	84.01	83.68	84.46	85.87	86.81	86.79	86.29	86.09	86.38
52.5 N	86.35	85.99	83.92	83.40	84.47	84.86	84.40	84.79	86.09	86.63	85.87	84.88	84.76	85.53	86.38	86.63	86.33	86.15	86.41
50.0 N	84.71	84.05	82.44	83.20	85.03	84.98	83.94	84.39	85.80	86.28	85.92	85.59	85.29	85.14	85.60	86.36	86.63	86.51	86.48
47.5 N	83.71	82.66	81.90	83.40	84.84	84.38	84.12	85.61	86.79	86.51	86.35	86.84	86.67	86.00	86.12	86.72	86.73	86.40	86.33
45.0 N	82.25	82.88	83.80	84.16	83.43	83.04	84.80	87.38	87.79	86.46	86.05	86.70	86.61	86.26	86.72	86.99	86.62	86.52	86.73
42.5 N	81.67	82.31	83.59	83.06	81.93	82.71	85.40	87.35	86.71	84.97	85.23	86.78	87.18	87.01	87.08	86.69	86.32	86.85	87.16
40.0 N	82.10	81.51	81.71	82.55	84.19	85.94	87.13	87.68	87.14	86.10	86.68	88.10	88.15	87.48	87.28	87.13	87.10	87.52	87.5
37.5 N	81.85	82.56	82.63	84.34	86.61	87.34	87.24	87.67	87.97	87.50	87.46	88.00	87.48	86.52	86.96	87.70	87.78	87.72	87.72
35.0 N	81.27	84.14	85.13	86.99	87.98	87.64	87.63	87.92	87.88	87.53	87.30	87.50	87.37	87.08	87.64	88.17	88.11	88.15	88.25
32.5 N	85.67	86.23	85.68	88.16	88.91	88.27	88.44	88.38	88.00	88.16	88.13	88.03	88.25	88.31	88.47	88.43	88.63	88.72	88.62
30.0 N	89.55	88.10	86.88	88.95	89.16	88.23	88.41	88.48	88.34	88.80	88.84	88.68	88.83	88.78	88.73	88.77	88.83	88.94	88.91
27.5 N	86.51	87.28	88.13	89.09	88.78	88.39	88.81	89.17	89.12	89.07	88.96	89.00	89.13	89.00	89.08	89.12	89.20	89.15	89.15

July

	105.0 E	107.5 E	110.0 E	112.5 E	115.0 E	117.5 E	120.0 E	122.5 E	125.0 E	127.5 E	130.0 E	132.5 E	135.0 E	137.5 E	140.0 E	142.5 E	145.0 E	147.5 E	150.0 E
55.0 N	88.67	87.42	85.99	85.84	86.67	87.19	87.29	87.62	88.11	88.13	87.63	87.31	87.67	88.28	88.50	88.23	87.81	87.69	87.97
52.5 N	89.14	88.76	87.02	86.75	87.87	88.18	87.62	87.79	88.68	89.01	88.55	87.99	87.90	88.15	88.30	88.19	87.93	87.85	88.04
50.0 N	88.04	87.18	85.32	85.87	87.51	87.49	86.72	87.22	88.30	88.55	88.33	88.30	88.27	88.04	87.96	88.11	88.15	88.02	87.97
47.5 N	85.76	84.50	83.82	85.48	86.88	86.59	86.75	88.15	88.90	88.59	88.49	88.89	88.85	88.33	88.15	88.29	88.19	87.95	87.88
45.0 N	82.86	83.77	85.14	85.92	85.47	85.53	87.58	89.47	89.49	88.56	88.29	88.61	88.45	88.17	88.35	88.41	88.13	88.06	88.21
42.5 N	82.20	83.38	85.04	85.10	84.70	85.93	88.30	89.48	88.90	87.78	87.84	88.52	88.61	88.58	88.72	88.44	88.12	88.39	88.62
40.0 N	83.48	83.43	84.24	86.02	88.01	89.14	89.45	89.46	89.04	88.39	88.65	89.27	89.20	88.93	88.99	88.95	88.86	89.10	89.14
37.5 N	84.44	85.73	86.51	88.39	89.92	89.80	89.21	89.18	89.20	88.95	88.99	89.29	89.02	88.59	89.09	89.62	89.64	89.59	89.61
35.0 N	84.26	87.55	88.72	89.92	90.22	89.76	89.46	89.33	89.09	88.97	89.04	89.25	89.27	89.29	89.75	90.04	90.01	90.04	90.07
32.5 N	88.38	89.07	88.87	90.63	90.94	90.49	90.31	89.90	89.42	89.41	89.55	89.63	89.81	89.98	90.01	89.92	89.90	90.02	90.02
30.0 N	91.97	90.64	89.72	91.56	91.59	90.71	90.57	90.18	89.64	89.57	89.65	89.65	89.72	89.76	89.71	89.65	89.64	89.66	89.64
27.5 N	89.78	89.71	90.52	91.53	91.08	90.40	90.46	90.14	89.65	89.47	89.44	89.35	89.28	89.26	89.31	89.37	89.36	89.32	89.34

October

	105.0 E	107.5 E	110.0 E	112.5 E	115.0 E	117.5 E	120.0 E	122.5 E	125.0 E	127.5 E	130.0 E	132.5 E	135.0 E	137.5 E	140.0 E	142.5 E	145.0 E	147.5 E	150.0 E
55.0 N	87.11	85.57	83.65	82.95	83.44	83.96	84.20	84.68	85.31	85.30	84.62	84.27	85.00	86.35	87.24	87.24	86.80	86.67	87.04
52.5 N	87.00	86.72	84.66	84.13	85.20	85.55	84.97	85.22	86.50	87.12	86.45	85							

ECM 1991 - 2000 Time Delay 0° Elevation (ns)

South East Asia

January

	90.0 E	92.5 E	95.0 E	97.5 E	100.0 E	102.5 E	105.0 E	107.5 E	110.0 E	112.5 E	115.0 E	117.5 E	120.0 E	122.5 E	125.0 E	127.5 E	130.0 E	132.5 E	135.0 E	137.5 E	140.0 E	142.5 E	145.0 E	147.5 E	150.0 E
25.0 N	298.52	290.24	290.42	279.61	261.66	262.94	274.81	286.69	294.26	291.71	291.07	295.46	300.72	306.16	307.08	306.00	305.17	304.96	305.3	304.96	305.97	306.06	305.9	306.93	306.48
22.5 N	299.83	286.74	278.30	278.69	278.00	283.21	292.22	300.43	299.62	295.67	303.46	307.87	305.98	308.42	308.88	308.93	309.14	308.17	308.58	308.46	309.04	309.27	309.33	310.45	309.98
20.0 N	303.34	299.72	291.22	285.62	284.94	290.97	300.34	307.31	306.72	306.39	312.81	313.02	311.19	313.60	312.68	311.93	311.49	310.78	311.82	311.32	311.45	312.21	312.01	312.23	312.31
17.5 N	303.16	306.65	301.25	294.08	293.91	299.19	305.04	309.90	313.11	313.13	313.29	312.83	311.27	312.01	314.67	313.99	314.18	314.22	314.03	314.74	314.77	314.17	313.87	313.26	
15.0 N	306.09	307.91	306.40	302.37	300.72	303.60	303.78	304.32	311.86	315.80	315.61	316.73	313.07	312.05	316.92	316.37	315.51	316.71	315.39	315.97	316.32	315.41	315.62	315.88	316.07
12.5 N	313.05	311.47	313.76	310.70	305.94	306.49	303.41	302.57	312.23	318.12	316.99	317.78	316.52	316.70	319.59	317.87	317.75	318.50	317.55	318.5	317.48	317.14	317.29	315.44	315.82
10.0 N	315.95	314.71	315.67	313.95	313.93	313.76	311.68	313.29	317.82	320.38	318.75	318.11	318.31	316.35	316.27	319.24	320.68	319.04	318.86	319.03	317.71	318.39	318.73	318.27	318.26
7.5 N	319.09	320.02	318.16	316.97	318.57	315.67	316.88	319.79	319.71	321.99	321.21	320.10	320.78	317.19	316.22	320.99	321.09	319.36	320.52	319.8	319.89	319.44	317.64	318.96	319.43
5.0 N	319.51	320.81	317.95	316.15	316.46	316.46	320.90	321.50	323.89	324.40	317.10	318.34	322.78	320.59	320.07	321.72	320.87	320.87	321.54	319.95	320.93	321.47	320.9	320.66	318.86
2.5 N	320.82	321.33	319.19	317.45	317.78	321.28	323.92	320.85	325.70	320.05	309.52	318.81	323.41	320.29	321.05	321.22	321.83	321.39	320.69	319.84	319.03	320.44	321.26	321.14	
0.0 N	319.17	320.61	321.33	321.92	321.65	323.16	325.41	322.55	324.64	317.56	314.89	323.70	319.07	316.81	321.12	320.16	321.38	320.96	320.81	323.48	324.06	322.73	320.85	319.15	320.02
2.5 S	320.15	320.39	320.10	321.35	320.07	320.23	325.52	324.95	324.69	324.75	326.55	325.01	315.40	318.20	323.17	320.27	321.34	322.04	318.76	315.42	316.78	320.89	323.6	324.5	320.84
5.0 S	320.37	320.44	319.99	321.50	320.78	320.40	323.69	322.46	322.15	324.89	325.84	323.59	321.07	323.89	324.18	322.12	323.51	324.06	320.11	314.03	311.41	308.47	309.45	319.73	321.93
7.5 S	318.76	319.55	319.69	320.62	321.23	321.43	322.12	321.18	321.16	320.79	320.37	322.03	323.00	322.44	321.31	322.22	323.18	322.72	323.14	324.58	325.4	317.17	306.84	311.83	320.32
10.0 S	319.13	319.32	318.69	318.71	319.36	319.87	320.52	320.90	320.85	320.20	320.95	321.21	320.04	320.44	320.89	322.14	323.61	323.19	323.5	323.2	324.75	327.09	322.11	317.08	318.97
12.5 S	317.50	317.15	317.05	317.46	317.57	317.58	317.76	317.95	318.49	319.33	320.51	319.78	319.89	322.67	322.51	323.49	326.41	324.68	323.87	321.72	318.15	320.96	323.2	320.74	319.05

April

	90.0 E	92.5 E	95.0 E	97.5 E	100.0 E	102.5 E	105.0 E	107.5 E	110.0 E	112.5 E	115.0 E	117.5 E	120.0 E	122.5 E	125.0 E	127.5 E	130.0 E	132.5 E	135.0 E	137.5 E	140.0 E	142.5 E	145.0 E	147.5 E	150.0 E
25.0 N	301.97	297.05	299.43	286.71	265.31	265.96	282.27	300.11	310.45	308.27	308.08	310.33	310.25	313.50	315.70	315.38	315.06	315.12	315.41	315.11	315.94	315.96	315.68	316.54	315.94
22.5 N	308.61	293.88	283.75	283.43	282.19	287.84	301.67	315.61	316.60	311.57	317.52	318.60	313.35	315.33	316.92	317.40	317.96	316.99	317.41	317.28	317.46	317.54	317.37	318.09	317.31
20.0 N	320.18	310.51	295.85	291.33	295.13	301.74	310.90	318.74	318.90	317.44	321.21	319.90	317.24	319.48	318.93	318.01	317.57	316.87	318.12	317.53	317.04	317.39	316.8	316.89	316.88
17.5 N	315.53	316.60	306.85	301.61	307.83	314.23	316.38	318.26	321.65	321.26	318.99	317.78	314.99	314.87	317.54	317.89	317.29	317.57	317.49	317.05	317.32	317.04	316.23	316.16	315.64
15.0 N	312.39	316.21	314.47	312.76	315.32	320.23	318.19	312.71	317.54	320.96	318.79	319.26	314.66	313.39	318.72	317.44	316.57	317.90	316.51	316.98	317.04	315.97	316.22	316.94	317.43
12.5 N	317.73	317.10	320.66	320.85	317.76	320.19	317.85	311.38	316.31	320.83	318.02	318.48	317.15	317.01	319.63	317.62	317.65	318.23	317.47	318.56	317.48	317.31	317.59	316.29	317.19
10.0 N	317.95	316.80	319.17	319.28	319.46	320.39	320.10	319.69	320.95	321.68	319.05	318.49	318.53	315.63	315.00	318.44	320.07	318.22	318.6	319.06	318.1	319.21	319.67	319.63	319.86
7.5 N	318.56	320.83	320.39	319.92	322.84	320.65	320.93	322.29	320.35	321.64	321.03	319.78	320.24	316.74	315.54	320.09	320.08	318.72	320.49	319.92	320.43	320.15	318.43	320.2	320.98
5.0 N	317.89	319.93	318.65	318.72	321.53	321.94	323.57	322.06	324.11	324.87	317.64	317.98	322.23	320.92	320.30	321.24	320.31	320.83	321.65	320.23	321.57	322.12	321.7	321.48	319.7
2.5 N	320.03	320.41	319.23	318.68	320.15	324.35	325.49	320.88	326.18	320.71	310.09	319.13	323.31	320.31	321.09	320.81	321.44	321.34	320.89	321.09	320.07	319.11	320.81	321.51	321.39
0.0 N	318.53	320.38	321.37	322.15	322.28	324.73	326.63	322.50	324.87	317.77	315.18	324.02	318.45	316.32	321.04	319.65	320.89	320.79	320.92	323.66	323.89	322.43	320.5	318.69	319.84
2.5 S	319.46	320.15	320.04	321.64	320.51	320.83	325.64	324.40	324.66	324.61	326.20	324.45	314.43	317.77	322.76	319.61	321.16	322.04	319.08	315.87	316.79	320.73	323.08	323.34	319.49
5.0 S	320.52	320.90	320.59	322.06	321.01	320.55	323.50	321.70	321.33	323.60	324.44	322.35	319.72	322.32	322.28	320.71	322.35	322.86	320.01	314.31	311.12	308.12	308.71	317.82	319.65
7.5 S	319.48	320.51	320.63	321.25	321.63	321.97	322.32	320.72	320.28	319.47	318.99	320.23	320.59	319.75	318.70	319.93	320.33	320.14	321.74	323.38	324.76	317.58	306.83	310.17	317.87
10.0 S	320.58	320.95	320.44	320.39	320.52	320.60	321.01	321.35	321.01	319.72	319.77	319.17	317.88	318.11	318.03	318.77	319.23	319.36	320.12	318.93	321.27	325.39	321.24	315.7	316.84
12.5 S	319.69	319.83	320.20	320.82	320.31	319.90	320.01	319.90	319.64	319.57	320.06	318.88	318.77	319.97	318.70	319.11	319.66	318.01	319.33	317.39	312.74	315.69	319.73	318.55	317

July

	90.0 E	92.5 E	95.0 E	97.5 E	100.0 E	102.5 E	105.0 E	107.5 E	110.0 E	112.5 E	115.0 E	117.5 E	120.0 E	122.5 E	125.0 E	127.5 E	130.0 E	132.5 E	135.0 E	137.5 E	140.0 E	142.5 E	145.0 E	147.5 E	150.0 E
25.0 N	329.11	321.63	322.46	308.88	289.01	289.28	300.04	312.62	322.52	320.38	319.84	321.89	321.00	322.38	323.30	322.54	322.28	322.08	321.66	321.03	321.48	321.2	320.52	320.89	320.41
22.5 N	331.27	320.08	314.20	309.98	303.63	306.22	315.57	328.03	329.60	323.34	327.35	327.29	320.82	321.21	321.80	321.71	322.00	320.87	321.04	320.99	321.14	320.99	320.42	320.85	320.26
20.0 N	328.55	327.05	324.57	316.40	308.98	312.04	320.96	328.19	327.40	324.73	327.24	324.96	321.92	323.71	322.69	321.46	320.81	320.00	320.98	320.45	320.05	320.33	319.64	319.68	319.81
17.5 N	324.93	327.71	328.09	323.42	319.09	320.90	322.56	322.04	324.67	326.19	324.33	322.64	319.82	318.64	321.14	322.10	321.19	321.30	321.21	320.83	321.11	320.93	320.2	319.82	319.02
15.0 N	325.64	325.19	326.59	327.42	324.99	326.56	322.95	314.66	319.66	326.40	324.87	325.01	320.66	317.88	323.19	322.51	321.02	322.28	320.77	321.23	321.5	320.84	321.1	321.04	321.1
12.5 N	326.29	324.26	326.62	327.69	325.23	327.53	325.43	316.99	319.30	325.21	323.38	323.55	322.47	321.05	323.13	321.50	322.13	323.29	322.11	323.29	322.29	322.1	322.15	319.96	320.35
10.0 N	324.51	323.76	323.90	324.29	325.97	325.75	327.05	326.99	324.32	325.16	323.34	322.12	322.88	320.00	318.84	321.96	324.13	322.74	322.84	323.47	321.9	322.42	322.62	322.09	322.02
7.5 N	323.44	324.89	323.68	324.13	327.64	323.21	323.84	325.66	322.07	323.81	323.32	322.30	324.16	321.43	320.48	323.95	323.35	322.19	323.99	323.24	322.9	322.18	319.96	321.37	322.34
5.0 N	321.00	322.69	320.48	319.57	323.11	323.91	325.11	322.64	324.70	325.85	318.98	321.33	325.87	323.90	323.59	323.84	322.92	323.62	324.06	322.27	323.17	323.65	322.92	322.55	320.68
2.5 N	321.55	322.18	320.03	318.47	320.30	324.93	326.15	321.00	326.20	320.27	310.34	321.17	324.55	321.22	322.58	322.22	323.42	322.84	321.85	322.12	320.95	319.97	321.74	322.73	322.21
0.0 N	319.30	320.93	321.61	322.52	321.89	323.57	325.78	321.59	323.60	316.22	314.39	323.85	317.34	316.05	321.50	320.37	322.03	321.51	322.05	324.84	325.02	323.89	321.81	320.2	320.96
2.5 S	320.30	320.73	320.03	320.92	319.10	319.25	324.02	322.40	323.01	322.84	324.78	323.12	312.24	315.85	321.47	319.07	320.78	321.53	319.07	315.7	317.39	321.94	323.8	325.2	321.86
5.0 S	320.70	320.93	320.13	321.04	319.74	319.07	320.98	318.73	318.87	320.68	321.66	319.87	316.73	319.31	319.40	318.08	319.99	320.99	318.03	312.39	310.14	306.79	305.68	316.48	321.62
7.5 S	320.04	320.23	319.64	320.08	319.88	319.85	319.57	317.35	316.63	315.73	315.69	316.87	317.07	315.76	313.62	314.34	315.72	317.42	319.19	320.24	321	312.83	301.47	305.43	317.11
10.0 S	320.15	319.93	318.87	318.44	318.17	318.34	318.35	318.18	317.35	315.78	315.60	314.50	313.12	312.07	311.03	311.18	309.74	309.96	313.56	314.28	314.18	317.84	316.93	311.56	313.96
12.5 S	316.88	317.25	317.63	317.82	317.30	316.86	316.35	316.36	315.82	315.28	315.38	313.51	312.75	311.83	309.54	308.16	302.12	297.15	304.71	311.07	305.15	305.73	314.14	313.85	311.7

October

	90.0 E	92.5 E	95.0 E	97.5 E	100.0 E	102.5 E	105.0 E	107.5 E	110.0 E	112.5 E	115.0 E	117.5 E	120.0 E	122.5 E	125.0 E	127.5 E	130.0 E	132.5 E	135.0 E	137.5 E	140.0 E	142.5 E	145.0 E	147.5 E	150.0 E
25.0 N	319.69	313.91	315.34	301.36	281.05	281.08	290.06	300.59	308.39	305.31	304.83	309.41	313.30	317.41	318.76	318.73	319.10	319.72	319.88	319.27	319.69	318.95	318.25	318.67	318.01
22.5 N	323.47	313.93	308.96	304.39	296.91	297.82	305.22	315.60	316.14	310.55	316.27	319.01	316.14	317.84	318.56	319.44	320.27	319.66	319.79	319.27	319.23	318.71	318.45	319.11	318.33
20.0 N	321.35	321.35	320.04	311.87	302.74	304.15	312.91	320.56	319.53	317.79	322.43	321.34	319.41	321.44	320.42	319.96	319.58	319.06	319.95	319.17	318.94	319.17	318.68	318.62	318.44
17.5 N	319.10	323.00	324.35	319.29	313.78	314.83	318.01	320.37	322.00	321.66	321.04	319.75	317.58	317.62	320.00	320.80	320.00	320.31	320.12	319.63	320.07	319.92	319.36	319.1	318.56
15.0 N	321.18	321.15	323.25	324.08	321.88	322.40	319.64	316.31	321.09	323.35	321.69	322.22	317.98	316.36	321.66	321.02	319.85	321.03	319.58	320.35	320.76	320.07	320.53	320.48	320.9
12.5 N	323.64	321.63	324.54	325.20	322.94	324.62	322.32	317.76	321.09	323.28	321.24	322.05	320.41	319.42	321.82	320.25	320.63	321.51	320.49	321.93	321.01	321.11	321.7	319.64	320.23
10.0 N	322.64	322.31	323.17	322.92	324.36	325.28	325.91	325.49	323.56	323.68	322.27	321.04	320.81	318.16	317.48	320.49	322.25	321.10	321.33	321.91	320.64	321.3	321.73	321.52	321.88
7.5 N	322.82	324.20	323.61	324.43	327.28	323.69	323.99	324.70	321.85	324.03	323.50	321.42	321.98	319.28	318.63	322.16	321.35	320.43	322.24	321.38	321.45	320.93	318.91	320.44	321.55
5.0 N	321.04	322.58	321.24	321.13	323.81	324.34	325.51	323.08	325.46	326.24	318.78	320.03	323.57	321.52	321.31	321.76	320.85	321.83	322.49	320.52	321.23	321.63	321.28	321.14	319.5
2.5 N	321.91	322.86	321.39	319.72	321.25	325.90	326.84	321.55	327.25	321.59	310.82	320.63	323.63	319.74	320.60	320.02	321.22	320.98	320.26	320.82	319.78	318.62	320.08	321.03	321.07
0.0 N	320.42	322.18	323.04	323.52	322.92	324.49	326.45	322.21	324.83	317.68	314.95	323.95	317.14	314.74	320.16	318.86	320.20	319.53	319.8	322.8	322.9	321.91	319.81	317.9	319.23
2.5 S	321.42	321.98	321.50	322.42	320.63	320.23	324.83	323.23	323.65	323.48	324.97	323.26	311.16	313.86	320.70	318.26	319.59	320.44	318.19	315.03	315.78	320.52	322.86	322.95	319.18
5.0 S	321.66	321.99	321.39	322.20	321.12	320.23	321.43	319.03	319.50	321.39	322.00	320.12	316.24	319.04	320.00	317.84	319.45	320.61	318	312.72	310.45	307.66	307.05	316.06	319.29
7.5 S	319.35	319.73	319.60	320.03	320.38	320.77	319.95	318.08	318.26	316.84	316.04	317.39	317.67	316.47	313.88	314.37	316.21	317.53	319.61	320.8	321.21	314.04	303.16	306.35	316.65
10.0 S	318.34	317.89	316.78	316.50	316.63	317.42	317.97	318.53	318.39	317.07	317.50	316.25	314.03	312.82	312.03	314.56	314.39	311.81	314.47	315.71	314.49	318.42	318.44	312.75	314.8
12.5 S	315.72	315.14	314.73	314.85	314.38	314.24	314.22	314.80	315.09	315.75	317.12	315.20	315.29	316.98	316.46	318.91	314.83	303.59	305.97	313.11	306.07	305.31	315.8	315.	

ECM 1991 - 2000 Time Delay 3° Elevation (ns)

South East Asia

January

	90.0 E	92.5 E	95.0 E	97.5 E	100.0 E	102.5 E	105.0 E	107.5 E	110.0 E	112.5 E	115.0 E	117.5 E	120.0 E	122.5 E	125.0 E	127.5 E	130.0 E	132.5 E	135.0 E	137.5 E	140.0 E	142.5 E	145.0 E	147.5 E	150.0 E
25.0 N	128.53	125.81	126.52	123.37	116.16	116.47	120.15	123.59	125.93	124.70	124.32	125.49	126.57	127.67	127.57	127.27	127.14	127.11	127.26	127.12	127.42	127.41	127.31	127.62	127.41
22.5 N	126.82	122.96	120.63	121.78	121.78	123.53	125.57	127.24	126.64	125.10	127.16	127.96	127.11	127.67	127.67	127.78	127.96	127.70	127.84	127.8	127.93	127.93	127.87	128.12	127.89
20.0 N	127.24	126.84	125.05	123.73	123.32	124.75	126.62	127.83	127.40	127.10	128.55	128.43	128.04	128.73	128.45	128.30	128.24	128.02	128.28	128.11	128.05	128.13	127.98	127.96	127.88
17.5 N	126.33	127.61	126.74	125.24	125.38	126.51	127.45	128.11	128.49	128.22	128.19	128.20	128.02	128.27	128.65	128.66	128.50	128.48	128.43	128.3	128.32	128.19	127.93	127.79	127.57
15.0 N	126.79	127.27	127.12	126.58	126.38	127.19	127.07	126.83	128.40	128.89	128.77	129.15	128.46	128.21	129.14	128.89	128.68	128.85	128.47	128.47	128.42	128.08	127.96	127.96	127.94
12.5 N	128.45	128.06	128.71	128.25	127.26	127.67	126.91	126.45	128.77	129.71	129.30	129.55	129.38	129.46	129.96	129.46	129.34	129.36	129.03	129.1	128.86	128.68	128.56	128.16	128.17
10.0 N	129.33	129.12	129.40	129.07	129.29	129.47	129.03	129.40	130.28	130.50	130.02	129.99	130.18	129.88	129.81	130.26	130.32	129.81	129.62	129.57	129.33	129.46	129.46	129.3	129.15
7.5 N	130.51	130.81	130.40	130.11	130.54	129.89	130.30	130.96	130.75	131.16	131.09	130.95	131.14	130.38	130.11	131.00	130.77	130.27	130.43	130.25	130.29	130.19	129.75	129.96	129.92
5.0 N	130.84	131.22	130.63	130.26	130.32	130.28	131.49	131.54	131.99	132.31	130.71	131.01	131.85	131.29	131.15	131.31	130.97	130.95	131.13	130.81	131.03	131.1	130.89	130.75	130.28
2.5 N	131.36	131.50	131.11	130.84	131.00	131.89	132.51	131.73	133.02	131.93	128.78	131.45	132.32	131.47	131.59	131.41	131.49	131.41	131.27	131.27	131.02	130.81	131.11	131.24	131.16
0.0 N	131.13	131.47	131.69	132.06	132.23	132.60	133.03	132.35	133.12	131.32	130.41	132.85	131.55	130.83	131.89	131.48	131.76	131.68	131.65	132.25	132.28	131.86	131.34	130.89	131.12
2.5 S	131.46	131.51	131.43	131.86	131.73	131.80	133.11	132.93	132.96	133.03	133.32	133.16	130.63	131.31	132.48	131.68	131.92	132.12	131.41	130.56	130.96	131.93	132.31	132.29	131.46
5.0 S	131.36	131.38	131.28	131.70	131.67	131.70	132.72	132.41	132.29	133.01	133.18	132.80	132.24	132.75	132.70	132.20	132.43	132.54	131.79	130.18	129.43	128.62	128.84	131.57	131.82
7.5 S	130.67	130.83	130.91	131.26	131.59	131.77	132.16	132.06	132.14	132.15	131.96	132.36	132.60	132.38	132.04	132.16	132.27	132.05	132.18	132.58	132.87	131.09	128.1	129.5	131.42
10.0 S	130.39	130.30	130.09	130.23	130.66	130.96	131.28	131.51	131.65	131.59	131.74	131.79	131.53	131.67	131.69	131.83	132.27	132.16	131.99	131.82	132.12	132.66	131.71	130.56	130.82
12.5 S	129.44	129.20	129.06	129.25	129.54	129.75	129.90	130.00	130.15	130.30	130.51	130.42	130.52	131.24	131.30	131.61	132.56	132.22	131.79	131.21	130.39	131.03	131.27	130.62	130.25

April

	90.0 E	92.5 E	95.0 E	97.5 E	100.0 E	102.5 E	105.0 E	107.5 E	110.0 E	112.5 E	115.0 E	117.5 E	120.0 E	122.5 E	125.0 E	127.5 E	130.0 E	132.5 E	135.0 E	137.5 E	140.0 E	142.5 E	145.0 E	147.5 E	150.0 E
25.0 N	129.19	127.35	128.69	125.55	117.44	117.50	122.64	127.25	129.76	128.83	128.83	129.59	129.41	130.11	130.45	130.24	130.13	130.12	130.21	130.1	130.3	130.23	130.07	130.27	130.06
22.5 N	128.05	124.54	122.20	123.20	123.16	124.90	128.17	130.91	130.60	129.15	130.74	130.89	129.35	129.73	129.90	129.90	130.04	129.81	129.94	129.93	129.94	129.9	129.81	129.95	129.75
20.0 N	128.31	128.13	125.93	125.25	126.26	127.56	129.31	130.53	130.21	129.80	130.53	130.18	129.59	129.99	129.57	129.23	129.17	129.03	129.34	129.25	129.11	129.15	128.99	128.99	129
17.5 N	126.52	127.93	127.46	127.01	128.73	129.85	130.01	130.12	130.45	130.03	129.43	129.25	128.76	128.62	128.82	128.70	128.64	128.73	128.79	128.74	128.73	128.6	128.37	128.38	128.34
15.0 N	126.66	127.71	128.18	128.67	129.60	130.67	130.42	129.03	129.76	129.78	129.10	129.30	128.49	128.11	128.94	128.58	128.45	128.71	128.49	128.56	128.47	128.12	128.09	128.35	128.56
12.5 N	128.39	128.38	129.34	130.01	129.86	130.61	130.35	128.67	129.57	129.90	129.11	129.22	129.02	129.01	129.37	128.86	128.81	128.87	128.7	128.88	128.67	128.54	128.53	128.44	128.74
10.0 N	129.20	129.10	129.79	130.09	130.35	130.57	130.63	130.57	130.55	130.33	129.69	129.53	129.56	129.10	128.94	129.47	129.60	129.21	129.26	129.37	129.28	129.55	129.64	129.72	129.84
7.5 N	130.01	130.68	130.80	130.84	131.49	130.79	130.77	131.02	130.48	130.70	130.61	130.28	130.31	129.71	129.48	130.27	130.09	129.81	130.24	130.22	130.46	130.44	130.03	130.45	130.66
5.0 N	130.24	130.86	130.79	131.08	131.84	131.62	131.73	131.31	131.93	132.33	130.60	130.49	131.16	130.89	130.82	130.83	130.57	130.76	131	130.79	131.22	131.36	131.18	131.08	130.68
2.5 N	130.96	131.12	131.05	131.24	131.78	132.66	132.60	131.53	133.24	132.12	128.74	131.19	131.89	131.14	131.33	131.07	131.21	131.27	131.17	131.17	130.89	130.68	131.09	131.22	131.14
0.0 N	130.64	131.12	131.48	132.05	132.40	132.92	133.08	132.11	133.14	131.27	130.25	132.61	131.09	130.42	131.58	131.09	131.38	131.41	131.51	132.03	131.8	131.33	130.87	130.45	130.73
2.5 S	130.83	131.06	131.12	131.78	131.78	131.83	132.87	132.44	132.64	132.62	132.76	132.60	130.02	130.84	131.97	131.20	131.55	131.76	131.19	130.39	130.56	131.42	131.62	131.39	130.5
5.0 S	130.97	131.19	131.22	131.70	131.60	131.53	132.33	131.75	131.50	131.98	132.08	131.82	131.28	131.72	131.62	131.36	131.66	131.70	131.24	129.8	128.89	128.07	128.15	130.39	130.43
7.5 S	130.53	130.88	131.02	131.25	131.44	131.56	131.76	131.34	131.16	130.94	130.71	130.98	131.06	130.78	130.53	130.85	130.84	130.68	131.06	131.47	131.92	130.54	127.55	128.35	129.85
10.0 S	130.60	130.69	130.61	130.67	130.79	130.83	130.96	131.06	131.01	130.72	130.62	130.40	130.07	130.13	130.19	130.19	130.26	130.24	130.27	129.89	130.34	131.17	130.5	129.31	129.3
12.5 S	130.24	130.29	130.34	130.46	130.38	130.31	130.36	130.35	130.31	130.23	130.24	129.95	130.21	130.08	130.31	130.58	130.15	130.21	129.48	128.28	128.9	129.58	129.25	128.9	

July

	90.0 E	92.5 E	95.0 E	97.5 E	100.0 E	102.5 E	105.0 E	107.5 E	110.0 E	112.5 E	115.0 E	117.5 E	120.0 E	122.5 E	125.0 E	127.5 E	130.0 E	132.5 E	135.0 E	137.5 E	140.0 E	142.5 E	145.0 E	147.5 E	150.0 E
25.0 N	135.13	133.49	134.23	131.22	125.20	125.36	127.96	130.67	133.12	132.20	131.87	132.27	131.59	131.36	131.14	130.84	130.75	130.60	130.51	130.47	130.68	130.7	130.55	130.64	130.59
22.5 N	134.14	131.99	130.89	130.49	129.28	130.07	132.09	134.52	134.29	132.41	133.05	132.76	130.99	130.77	130.60	130.43	130.46	130.20	130.32	130.44	130.54	130.55	130.43	130.56	130.51
20.0 N	133.65	133.74	133.78	131.94	129.80	130.52	132.57	133.66	133.15	132.24	132.48	131.98	131.24	131.38	130.83	130.43	130.31	130.09	130.33	130.3	130.26	130.33	130.15	130.2	130.27
17.5 N	132.94	133.68	134.19	133.49	132.27	132.57	132.71	132.17	132.61	132.67	132.02	131.82	131.24	130.64	130.86	130.86	130.66	130.64	130.59	130.5	130.55	130.55	130.35	130.19	129.96
15.0 N	133.19	133.16	133.71	134.30	133.64	133.95	133.00	130.35	131.62	132.99	132.40	132.60	131.71	130.78	131.81	131.43	131.05	131.32	130.94	130.99	130.97	130.85	130.86	130.61	130.43
12.5 N	133.36	133.07	133.83	134.31	133.70	134.26	133.79	131.18	131.64	132.90	132.26	132.39	132.30	131.94	132.30	131.69	131.78	132.06	131.78	132.03	131.67	131.52	131.43	130.7	130.61
10.0 N	133.08	133.03	133.19	133.32	133.80	133.66	133.98	133.90	133.00	132.99	132.47	132.21	132.52	131.90	131.54	132.13	132.56	132.27	132.33	132.48	131.9	131.85	131.82	131.59	131.53
7.5 N	132.92	133.37	133.19	133.30	134.22	132.90	132.91	133.30	132.27	132.78	132.76	132.45	132.86	132.29	132.06	132.77	132.53	132.28	132.78	132.52	132.25	131.94	131.35	131.71	131.99
5.0 N	132.19	132.73	132.34	132.13	133.04	132.96	133.15	132.48	133.12	133.75	131.94	132.45	133.31	132.83	132.80	132.77	132.54	132.74	132.84	132.33	132.47	132.51	132.26	132.13	131.63
2.5 N	132.15	132.37	131.98	131.65	132.07	133.01	133.24	132.00	133.68	132.43	129.22	132.48	133.10	132.23	132.62	132.44	132.78	132.62	132.27	132.27	131.92	131.61	132.05	132.24	131.98
0.0 N	131.30	131.74	131.97	132.43	132.36	132.56	132.90	131.89	132.78	130.87	130.29	133.13	131.24	130.91	132.42	131.97	132.46	132.34	132.48	133.08	132.99	132.62	132.03	131.56	131.67
2.5 S	131.38	131.49	131.27	131.60	131.29	131.23	132.24	131.75	132.12	132.20	132.67	132.53	129.51	130.64	132.11	131.41	131.92	132.17	131.68	130.77	131.29	132.5	132.77	132.88	131.94
5.0 S	131.29	131.32	131.06	131.27	131.01	130.83	131.23	130.55	130.60	131.09	131.34	131.06	130.34	131.02	131.01	130.72	131.16	131.42	130.95	129.52	128.95	128.07	127.77	130.9	131.82
7.5 S	131.00	130.91	130.65	130.66	130.55	130.49	130.42	129.82	129.62	129.45	129.43	129.68	129.75	129.47	128.97	129.19	129.47	129.85	130.39	130.82	131.28	129.55	126.25	127.41	130.29
10.0 S	130.92	130.67	130.20	129.91	129.78	129.78	129.69	129.59	129.39	129.02	128.95	128.64	128.30	128.10	127.85	127.96	127.74	127.84	128.55	128.58	128.64	129.67	129.66	128.42	128.83
12.5 S	129.78	129.82	129.72	129.58	129.46	129.36	129.13	129.09	128.94	128.74	128.68	128.20	128.04	127.93	127.55	127.57	126.54	125.33	126.85	127.88	126.24	126.34	128.19	127.97	127.53

October

	90.0 E	92.5 E	95.0 E	97.5 E	100.0 E	102.5 E	105.0 E	107.5 E	110.0 E	112.5 E	115.0 E	117.5 E	120.0 E	122.5 E	125.0 E	127.5 E	130.0 E	132.5 E	135.0 E	137.5 E	140.0 E	142.5 E	145.0 E	147.5 E	150.0 E
25.0 N	132.18	130.98	132.15	129.06	122.70	122.77	125.06	127.59	129.72	128.48	128.18	129.32	130.03	130.79	130.79	130.58	130.53	130.60	130.52	130.22	130.2	129.88	129.58	129.62	129.43
22.5 N	131.42	129.73	129.10	128.65	127.10	127.51	128.96	131.28	131.09	129.25	130.64	131.03	130.02	130.26	130.17	130.20	130.32	130.14	130.08	129.89	129.82	129.62	129.47	129.53	129.31
20.0 N	131.44	131.89	132.16	130.20	127.55	127.97	130.11	131.74	131.21	130.48	131.29	130.87	130.42	130.77	130.30	130.12	130.07	129.89	130.02	129.84	129.74	129.75	129.6	129.53	129.41
17.5 N	131.12	132.20	132.79	131.71	130.22	130.56	131.29	131.61	131.65	131.20	130.80	130.49	130.10	130.01	130.29	130.38	130.24	130.24	130.17	130.05	130.12	130.14	130.04	129.94	129.75
15.0 N	131.90	131.89	132.49	132.82	132.24	131.72	130.61	131.55	131.64	131.05	131.23	130.38	129.86	130.89	130.68	130.43	130.67	130.36	130.56	130.67	130.59	130.72	130.63	130.63	
12.5 N	132.72	132.24	133.01	133.25	132.66	133.03	132.46	131.07	131.70	131.86	131.25	131.46	131.15	130.86	131.25	130.79	130.88	131.13	130.96	131.34	131.13	131.15	131.29	130.73	130.81
10.0 N	132.54	132.56	132.88	132.89	133.26	133.32	133.36	133.17	132.49	132.32	131.89	131.51	131.43	130.81	130.51	131.07	131.45	131.37	131.53	131.68	131.27	131.33	131.41	131.32	131.46
7.5 N	132.69	133.13	133.14	133.52	134.31	133.11	132.95	133.03	132.24	132.79	132.65	131.91	131.81	131.15	130.93	131.60	131.38	131.37	131.91	131.64	131.5	131.29	130.79	131.2	131.6
5.0 N	132.20	132.70	132.57	132.78	133.59	133.43	133.49	132.78	133.44	133.81	131.80	131.83	132.18	131.57	131.54	131.51	131.32	131.71	131.9	131.36	131.45	131.5	131.42	131.41	131.09
2.5 N	132.34	132.68	132.50	132.28	132.74	133.72	133.77	132.41	134.14	132.84	129.34	131.96	132.25	131.21	131.41	131.12	131.44	131.44	131.23	131.29	130.98	130.69	131.1	131.35	131.34
0.0 N	131.87	132.35	132.62	133.04	133.03	133.17	133.40	132.35	133.34	131.38	130.31	132.72	130.86	130.14	131.45	130.95	131.31	131.15	131.24	131.86	131.69	131.33	130.82	130.41	130.77
2.5 S	132.06	132.20	132.01	132.37	132.07	131.80	132.73	132.20	132.38	132.26	132.38	132.21	129.10	131.34	130.70	131.09	131.35	131.02	130.27	130.42	131.43	131.67	131.51	130.67	
5.0 S	131.97	132.06	131.82	131.95	131.69	131.41	131.66	130.88	130.82	131.11	131.09	130.76	129.90	130.46	130.58	130.19	130.55	130.81	130.56	129.42	128.88	128.16	127.88	130.22	130.6
7.5 S	131.00	131.04	130.94	130.96	130.97	131.02	130.87	130.29	130.15	129.71	129.36	129.53	129.55	129.28	128.66	128.73	129.03	129.32	129.98	130.5	130.97	129.69	126.65	127.49	129.77
10.0 S	130.14	129.92	129.52	129.39	129.45	129.63	129.71	129.69	129.52	129.19	129.20	128.81	128.26	128.00	127.72	128.05	128.08	127.72	128.23	128.42	128.43	129.64	129.88	128.64	128.92
12.5 S	128.99	128.73	128.47	128.44	128.45	128.46	128.38	128.40	128.32	128.29	128.41	127.93	127.77	128.06	128.09	128.73	128.60	126.43	126.67	127.77	126.2	126.11	128.42	128.33	127

ECM 1991 - 2000 Time Delay 5° Elevation (ns)

South East Asia

January

	90.0 E	92.5 E	95.0 E	97.5 E	100.0 E	102.5 E	105.0 E	107.5 E	110.0 E	112.5 E	115.0 E	117.5 E	120.0 E	122.5 E	125.0 E	127.5 E	130.0 E	132.5 E	135.0 E	137.5 E	140.0 E	142.5 E	145.0 E	147.5 E	150.0 E
25.0 N	87.93	86.68	87.04	85.39	80.98	81.22	83.53	85.59	86.82	86.22	86.03	86.59	87.04	87.43	87.32	87.21	87.18	87.19	87.26	87.22	87.34	87.35	87.33	87.48	87.4
22.5 N	87.19	85.35	83.93	84.55	84.52	85.52	86.58	87.36	87.08	86.36	87.19	87.47	87.16	87.40	87.41	87.48	87.58	87.48	87.54	87.54	87.59	87.58	87.55	87.61	87.51
20.0 N	87.14	87.13	86.38	85.70	85.48	86.22	87.00	87.42	87.23	87.11	87.57	87.57	87.52	87.78	87.74	87.72	87.70	87.61	87.68	87.63	87.57	87.55	87.46	87.4	87.33
17.5 N	86.70	87.19	87.01	86.42	86.52	86.97	87.28	87.47	87.56	87.50	87.52	87.60	87.63	87.75	87.85	87.81	87.75	87.70	87.64	87.57	87.49	87.38	87.25	87.16	87.06
15.0 N	86.92	87.06	87.03	86.92	86.89	87.22	87.22	87.15	87.76	87.87	87.87	87.97	87.86	87.82	88.00	87.91	87.84	87.80	87.68	87.59	87.5	87.33	87.16	87.1	87.04
12.5 N	87.65	87.54	87.71	87.64	87.34	87.56	87.30	87.14	88.16	88.40	88.28	88.31	88.29	88.34	88.41	88.30	88.23	88.12	87.98	87.87	87.81	87.69	87.54	87.47	87.4
10.0 N	88.33	88.32	88.37	88.27	88.37	88.45	88.33	88.55	88.90	88.89	88.76	88.78	88.87	88.85	88.83	88.89	88.77	88.55	88.38	88.3	88.28	88.26	88.2	88.12	87.98
7.5 N	89.09	89.19	89.02	88.89	88.97	88.83	89.08	89.37	89.34	89.38	89.39	89.39	89.43	89.25	89.16	89.32	89.17	88.97	88.9	88.86	88.87	88.85	88.72	88.68	88.56
5.0 N	89.45	89.54	89.35	89.18	89.16	89.23	89.74	89.83	89.92	90.00	89.55	89.64	89.84	89.66	89.59	89.53	89.40	89.37	89.41	89.36	89.37	89.36	89.26	89.18	89.04
2.5 N	89.69	89.72	89.65	89.60	89.71	90.12	90.35	90.21	90.60	90.26	88.79	89.91	90.18	89.87	89.84	89.71	89.70	89.70	89.69	89.72	89.62	89.53	89.56	89.52	89.48
0.0 N	89.74	89.80	89.90	90.12	90.35	90.57	90.69	90.59	90.88	90.13	89.63	90.52	90.08	89.72	90.10	89.94	90.00	89.99	89.94	90.06	90.03	89.91	89.77	89.6	89.63
2.5 S	89.86	89.87	89.89	90.10	90.18	90.27	90.74	90.71	90.71	90.74	90.76	90.76	89.80	89.96	90.37	90.15	90.19	90.27	89.99	89.59	89.69	89.99	90.03	89.96	89.79
5.0 S	89.72	89.73	89.74	89.89	89.97	90.12	90.61	90.57	90.46	90.77	90.81	90.70	90.49	90.51	90.49	90.37	90.36	90.37	90.18	89.49	89.07	88.63	88.75	89.87	89.9
7.5 S	89.34	89.36	89.43	89.63	89.86	90.02	90.29	90.36	90.41	90.51	90.41	90.50	90.59	90.47	90.34	90.33	90.32	90.20	90.17	90.27	90.3	89.74	88.4	89.05	89.73
10.0 S	88.99	88.87	88.78	88.93	89.25	89.47	89.65	89.82	89.94	90.00	90.04	90.07	90.05	90.11	90.09	90.08	90.33	90.32	90.07	89.96	89.99	89.96	89.69	89.33	89.37
12.5 S	88.33	88.14	88.00	88.09	88.35	88.56	88.67	88.76	88.84	88.88	88.92	88.98	89.10	89.37	89.49	89.68	90.16	90.12	89.79	89.58	89.4	89.58	89.39	89.06	88.93

April

	90.0 E	92.5 E	95.0 E	97.5 E	100.0 E	102.5 E	105.0 E	107.5 E	110.0 E	112.5 E	115.0 E	117.5 E	120.0 E	122.5 E	125.0 E	127.5 E	130.0 E	132.5 E	135.0 E	137.5 E	140.0 E	142.5 E	145.0 E	147.5 E	150.0 E
25.0 N	88.37	87.52	88.11	86.72	81.88	81.98	85.28	87.77	88.89	88.57	88.61	88.97	88.87	89.10	89.20	89.10	89.04	89.04	89.07	89.05	89.1	89.06	89	89.05	88.97
22.5 N	87.70	86.34	85.02	85.53	85.51	86.52	88.16	89.28	89.14	88.66	89.24	89.26	88.65	88.71	88.73	88.69	88.70	88.65	88.7	88.72	88.7	88.65	88.61	88.62	88.57
20.0 N	86.46	87.37	86.96	86.68	87.22	87.83	88.61	88.95	88.80	88.70	88.77	88.63	88.44	88.42	88.22	88.07	88.06	88.05	88.12	88.14	88.08	88.05	88	87.96	87.97
17.5 N	85.91	86.69	87.42	87.57	88.29	88.68	88.75	88.75	88.65	88.45	88.24	88.15	88.04	87.92	87.75	87.62	87.65	87.68	87.74	87.77	87.7	87.6	87.52	87.52	87.58
15.0 N	86.52	86.81	87.43	88.02	88.55	88.93	89.00	88.56	88.60	88.25	87.97	87.92	87.82	87.68	87.67	87.61	87.61	87.63	87.66	87.63	87.53	87.35	87.25	87.39	87.51
12.5 N	87.27	87.42	87.77	88.35	88.73	89.06	89.09	88.46	88.64	88.37	88.10	88.02	87.96	87.95	87.91	87.84	87.79	87.75	87.73	87.7	87.67	87.57	87.52	87.65	87.78
10.0 N	88.11	88.24	88.53	88.83	89.01	89.02	89.08	89.08	88.91	88.65	88.49	88.36	88.30	88.26	88.22	88.26	88.19	88.11	88.1	88.13	88.2	88.26	88.27	88.36	88.46
7.5 N	88.75	89.02	89.21	89.37	89.53	89.27	89.22	89.27	89.11	89.08	89.01	88.85	88.76	88.72	88.68	88.77	88.68	88.65	88.75	88.84	88.99	89.02	88.93	89.01	89.09
5.0 N	89.10	89.35	89.46	89.73	90.07	89.92	89.74	89.62	89.90	90.00	89.40	89.24	89.31	89.27	89.27	89.16	89.11	89.21	89.29	89.34	89.5	89.55	89.46	89.41	89.34
2.5 N	89.40	89.49	89.61	89.88	90.26	90.57	90.34	90.09	90.78	90.39	88.72	89.66	89.81	89.59	89.63	89.47	89.50	89.60	89.6	89.6	89.51	89.44	89.51	89.5	89.46
0.0 N	89.36	89.50	89.70	90.11	90.49	90.73	90.62	90.41	90.90	90.10	89.48	90.27	89.77	89.43	89.84	89.68	89.73	89.79	89.84	89.87	89.64	89.47	89.39	89.28	89.3
2.5 S	89.39	89.51	89.64	90.01	90.20	90.26	90.53	90.36	90.42	90.41	90.31	90.34	89.37	89.58	89.95	89.80	89.87	89.94	89.78	89.41	89.36	89.56	89.47	89.28	89.07
5.0 S	89.38	89.53	89.65	89.85	89.93	89.98	90.31	90.07	89.86	90.00	89.99	89.95	89.78	89.74	89.73	89.77	89.79	89.77	89.7	89.13	88.66	88.22	88.24	89.04	88.9
7.5 S	89.17	89.34	89.47	89.59	89.71	89.78	89.92	89.78	89.63	89.57	89.42	89.43	89.45	89.30	89.24	89.36	89.31	89.22	89.29	89.39	89.5	89.19	87.91	88.2	88.58
10.0 S	89.05	89.09	89.11	89.18	89.29	89.31	89.36	89.39	89.36	89.27	89.14	89.03	88.92	88.91	88.88	88.87	88.88	88.88	88.81	88.66	88.75	88.76	88.66	88.34	88.23
12.5 S	88.87	88.88	88.88	88.88	88.87	88.90	88.92	88.89	88.82	88.71	88.60	88.54	88.61	88.67	88.78	88.78	88.68	88.34	87.98	88.18	88.19	88.03	87.91		

July

	90.0 E	92.5 E	95.0 E	97.5 E	100.0 E	102.5 E	105.0 E	107.5 E	110.0 E	112.5 E	115.0 E	117.5 E	120.0 E	122.5 E	125.0 E	127.5 E	130.0 E	132.5 E	135.0 E	137.5 E	140.0 E	142.5 E	145.0 E	147.5 E	150.0 E
25.0 N	91.26	90.91	91.20	89.91	86.90	87.03	88.60	89.92	91.04	90.67	90.44	90.45	90.00	89.63	89.34	89.18	89.10	88.97	88.93	88.99	89.08	89.14	89.11	89.11	89.15
22.5 N	91.21	90.67	90.03	89.74	89.19	89.51	90.51	91.49	91.27	90.53	90.47	90.20	89.52	89.22	89.03	88.88	88.82	88.75	88.82	88.93	88.99	89	88.97	89	89.05
20.0 N	91.04	91.20	91.32	90.50	89.40	89.69	90.68	90.92	90.71	90.29	90.04	89.89	89.57	89.33	89.05	88.89	88.85	88.76	88.82	88.88	88.89	88.89	88.82	88.82	88.87
17.5 N	90.90	91.12	91.45	91.31	90.65	90.65	90.63	90.32	90.43	90.39	90.09	90.05	89.82	89.42	89.28	89.17	89.11	89.05	89	88.98	88.97	88.99	88.92	88.8	88.71
15.0 N	90.93	91.00	91.31	91.67	91.38	91.38	90.91	89.58	90.11	90.56	90.33	90.34	90.08	89.63	89.80	89.63	89.51	89.54	89.44	89.4	89.34	89.33	89.27	89.02	88.82
12.5 N	90.94	90.98	91.33	91.64	91.49	91.65	91.42	90.10	90.22	90.63	90.37	90.38	90.36	90.20	90.22	89.99	90.01	90.09	90.02	90.06	89.88	89.77	89.67	89.32	89.14
10.0 N	90.94	90.99	91.12	91.23	91.43	91.33	91.38	91.27	90.80	90.67	90.49	90.41	90.52	90.34	90.17	90.31	90.43	90.39	90.44	90.48	90.17	90	89.91	89.78	89.74
7.5 N	90.87	91.02	91.03	91.11	91.45	90.98	90.89	90.96	90.57	90.70	90.71	90.57	90.66	90.54	90.44	90.61	90.53	90.49	90.66	90.55	90.32	90.13	89.93	90.01	90.12
5.0 N	90.53	90.72	90.66	90.60	90.97	90.89	90.84	90.62	90.88	91.15	90.46	90.60	90.84	90.71	90.68	90.64	90.59	90.67	90.67	90.47	90.43	90.37	90.28	90.22	90.06
2.5 N	90.30	90.40	90.35	90.27	90.46	90.78	90.80	90.46	91.11	90.66	89.09	90.55	90.77	90.48	90.61	90.55	90.69	90.64	90.49	90.47	90.33	90.17	90.26	90.26	90.1
0.0 N	89.87	90.00	90.11	90.37	90.45	90.51	90.52	90.27	90.66	89.86	89.57	90.73	90.00	89.84	90.49	90.35	90.54	90.53	90.54	90.65	90.58	90.46	90.29	90.09	90.03
2.5 S	89.78	89.81	89.75	89.91	89.90	89.87	90.10	89.92	90.07	90.16	90.34	90.35	89.09	89.55	90.18	89.98	90.20	90.34	90.16	89.73	89.91	90.35	90.4	90.37	90.09
5.0 S	89.66	89.63	89.53	89.55	89.50	89.46	89.55	89.27	89.25	89.47	89.58	89.46	89.17	89.37	89.40	89.37	89.52	89.66	89.6	89.04	88.73	88.26	88.16	89.61	89.89
7.5 S	89.50	89.37	89.22	89.14	89.06	89.01	88.96	88.71	88.57	88.56	88.53	88.54	88.54	88.43	88.25	88.32	88.41	88.57	88.81	89.02	89.21	88.68	87.2	87.82	89.02
10.0 S	89.35	89.15	88.87	88.65	88.58	88.54	88.42	88.33	88.20	88.06	87.98	87.85	87.71	87.57	87.43	87.41	87.33	87.43	87.69	87.74	87.83	88.09	88.13	87.84	88.02
12.5 S	88.67	88.67	88.52	88.33	88.30	88.26	88.12	88.06	87.97	87.82	87.68	87.45	87.30	87.20	87.05	87.05	86.77	86.38	86.89	87.17	86.64	86.72	87.26	87.18	87.12

October

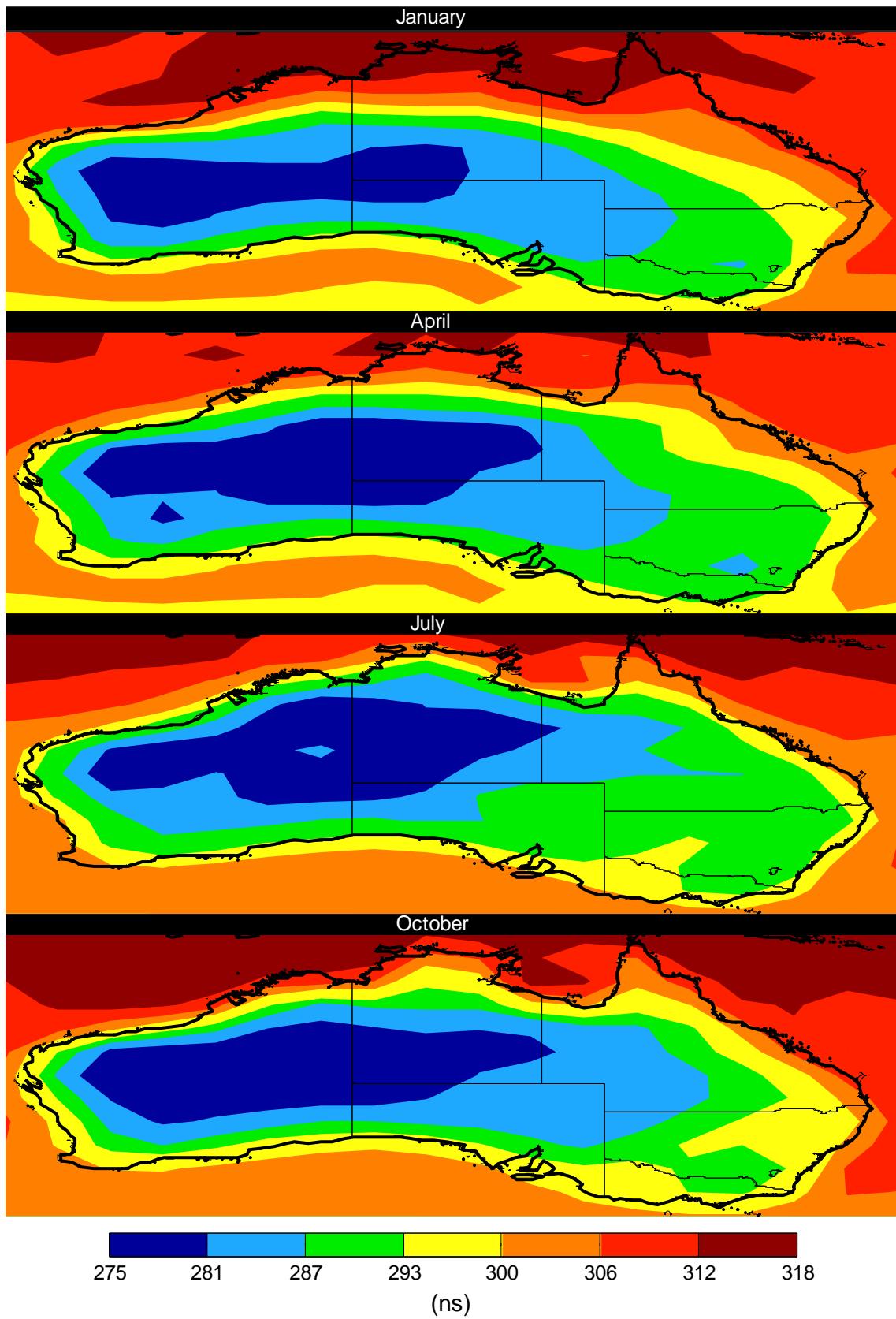
	90.0 E	92.5 E	95.0 E	97.5 E	100.0 E	102.5 E	105.0 E	107.5 E	110.0 E	112.5 E	115.0 E	117.5 E	120.0 E	122.5 E	125.0 E	127.5 E	130.0 E	132.5 E	135.0 E	137.5 E	140.0 E	142.5 E	145.0 E	147.5 E	150.0 E
25.0 N	89.34	89.27	89.86	88.66	85.28	85.31	86.73	88.09	89.10	88.54	88.35	88.81	89.10	89.37	89.30	89.16	89.10	89.11	89.02	88.86	88.75	88.58	88.42	88.38	88.32
22.5 N	89.38	89.12	88.85	88.55	87.80	87.90	88.58	89.66	89.58	88.77	89.24	89.34	88.97	88.99	88.89	88.80	88.80	88.75	88.67	88.57	88.5	88.39	88.29	88.22	88.16
20.0 N	89.66	90.03	90.24	89.28	87.92	88.09	89.15	89.83	89.59	89.22	89.27	89.11	88.98	88.96	88.77	88.70	88.72	88.65	88.61	88.57	88.5	88.46	88.4	88.31	88.23
17.5 N	89.74	90.18	90.49	90.04	89.27	89.40	89.75	89.86	89.77	89.51	89.23	89.09	88.98	88.89	88.86	88.85	88.84	88.78	88.73	88.7	88.69	88.72	88.72	88.65	88.56
15.0 N	90.16	90.21	90.50	90.63	90.35	90.37	90.10	89.58	89.83	89.68	89.40	89.37	89.16	88.94	89.13	89.11	89.06	89.06	89.03	89.08	89.12	89.17	89.2	89.1	89.02
12.5 N	90.59	90.46	90.76	90.92	90.74	90.80	90.56	89.91	90.03	89.90	89.66	89.65	89.53	89.38	89.40	89.30	89.35	89.44	89.45	89.56	89.53	89.54	89.57	89.37	89.33
10.0 N	90.63	90.69	90.87	90.97	91.11	91.02	90.93	90.78	90.43	90.25	90.09	89.87	89.75	89.54	89.37	89.50	89.62	89.74	89.85	89.9	89.72	89.64	89.63	89.59	89.67
7.5 N	90.69	90.87	90.98	91.26	91.59	91.09	90.89	90.84	90.56	90.68	90.57	90.16	89.93	89.72	89.61	89.72	89.71	89.85	90.06	89.94	89.78	89.66	89.52	89.64	89.84
5.0 N	90.51	90.72	90.78	91.00	91.42	91.28	91.11	90.85	91.09	91.19	90.39	90.20	90.07	89.83	89.79	89.71	89.70	89.92	89.98	89.78	89.72	89.69	89.68	89.71	89.7
2.5 N	90.44	90.62	90.67	90.71	90.98	91.32	91.20	90.79	91.43	90.90	89.16	90.15	90.07	89.69	89.71	89.60	89.70	89.75	89.69	89.69	89.57	89.45	89.56	89.63	89.63
0.0 N	90.26	90.43	90.55	90.84	90.97	90.97	90.90	90.64	91.04	90.18	89.56	90.33	89.67	89.29	89.74	89.59	89.70	89.67	89.69	89.77	89.63	89.5	89.41	89.3	89.38
2.5 S	90.28	90.33	90.27	90.45	90.44	90.28	90.44	90.23	90.25	90.17	90.08	90.06	88.89	89.05	89.57	89.45	89.60	89.71	89.66	89.35	89.33	89.55	89.48	89.38	89.22
5.0 S	90.16	90.19	90.07	90.05	89.96	89.86	89.91	89.56	89.40	89.43	89.33	89.16	88.85	88.89	88.92	88.95	89.06	89.18	89.29	88.93	88.66	88.28	88.12	89.03	89.03
7.5 S	89.57	89.54	89.46	89.41	89.37	89.36	89.34	89.08	88.88	88.72	88.50	88.39	88.33	88.21	88.02	88.01	88.03	88.16	88.45	88.7	88.96	88.72	87.83	88.59	
10.0 S	88.82	88.66	88.44	88.36	88.42	88.47	88.47	88.37	88.22	88.13	88.05	87.88	87.69	87.57	87.43	87.34	87.29	87.30	87.4	87.44	87.64	88.04	88.2	87.98	88.05
12.5 S	88.05	87.87	87.64	87.57	87.65	87.69	87.64	87.60	87.50	87.41	87.32	87.17	86.99	86.93	87.04	87.17	87.41	86.92	86.83	86.96	86.64	86.69	87.34	87.35	

Appendix D

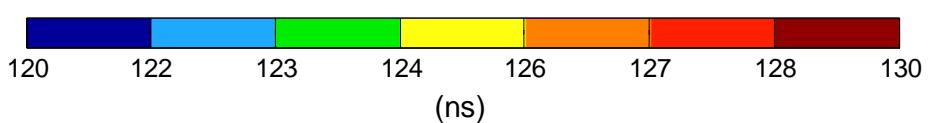
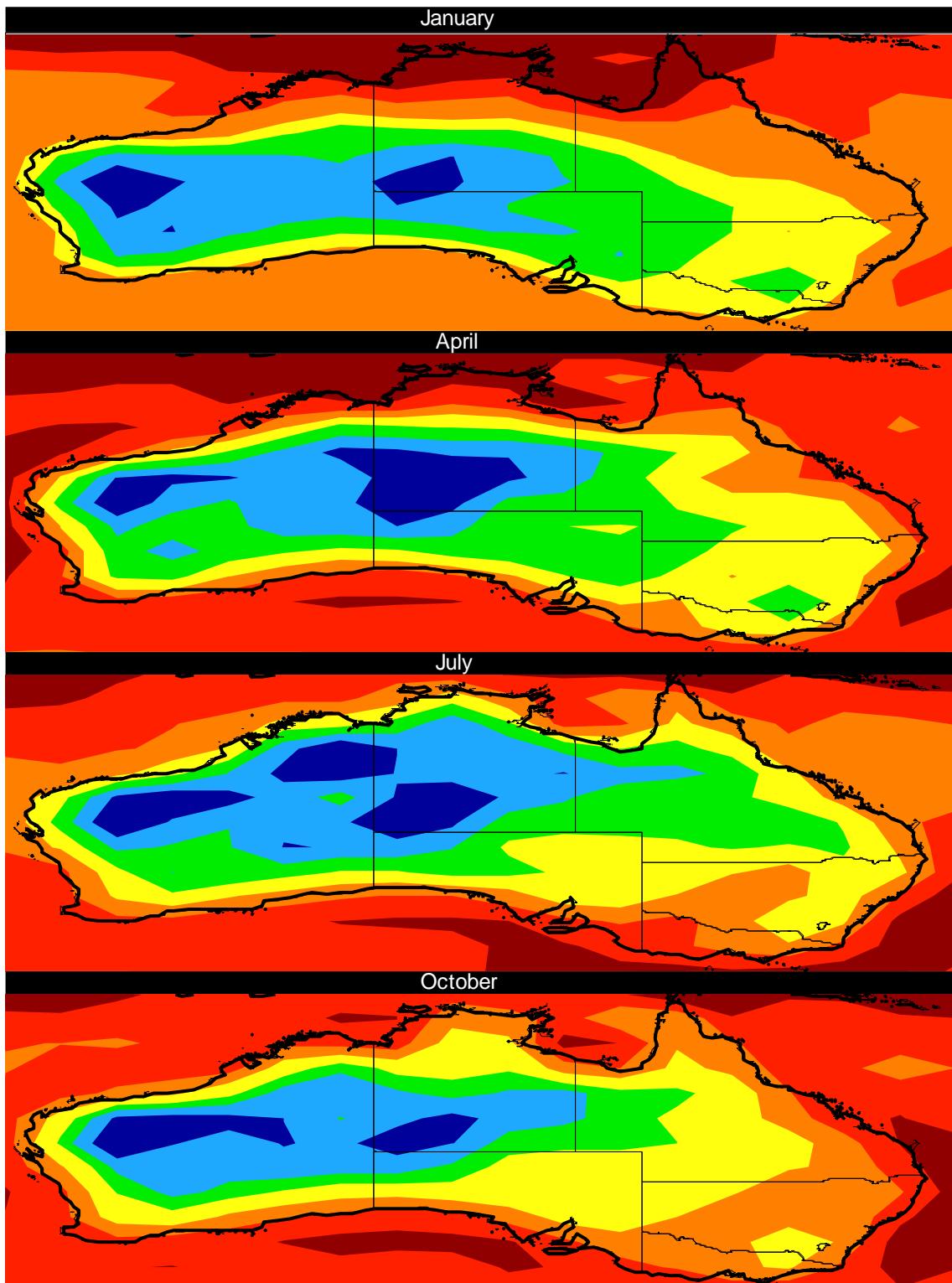
**ECM 1991-2000 TIME DELAYS
JANUARY, APRIL, JULY, OCTOBER
0 AND 3° ELEVATION ANGLES**

**AUSTRALIA
EUROPE
SAHARA DESERT**

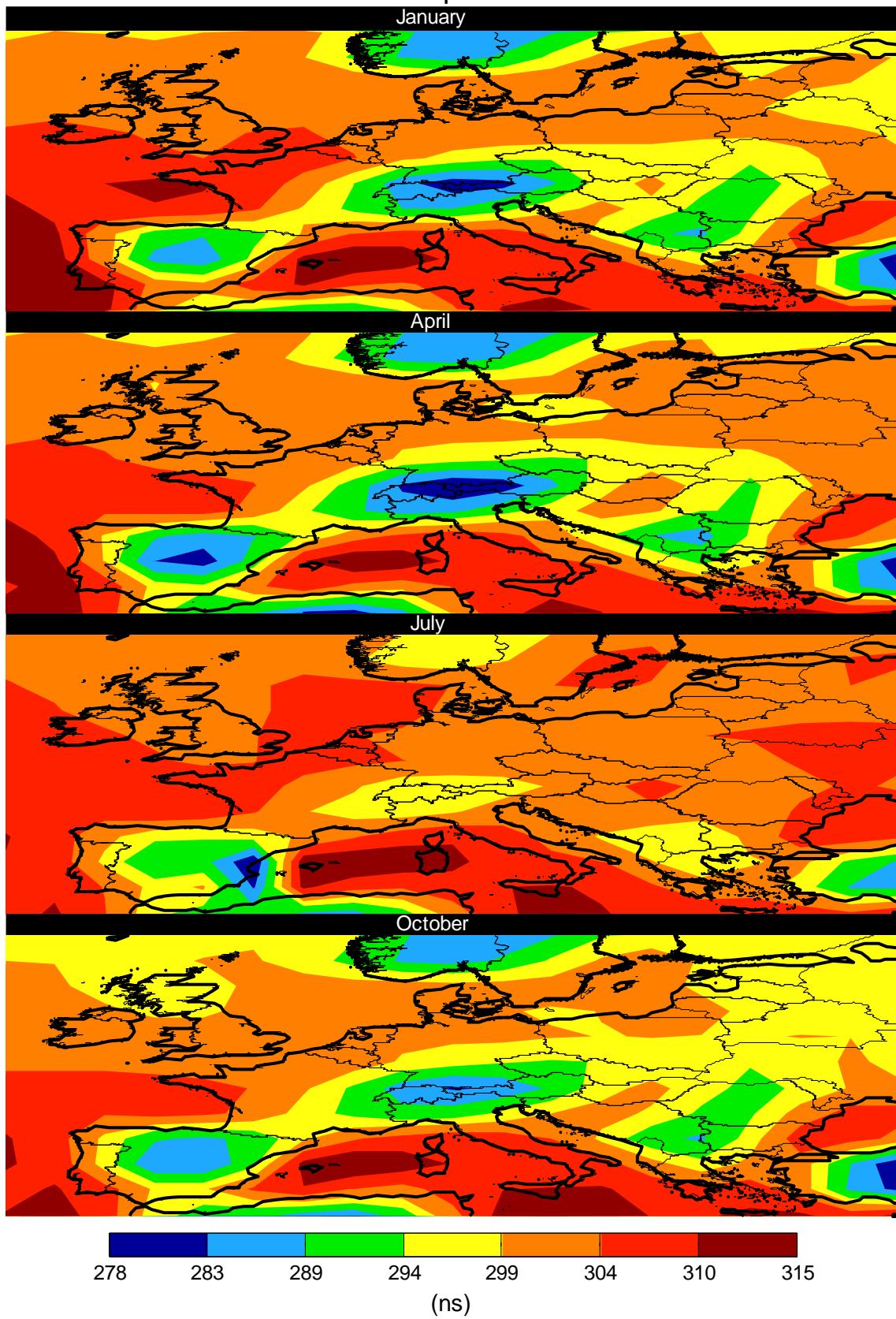
ECM 1991-2000 Time Delay 0° Elevation
Australia



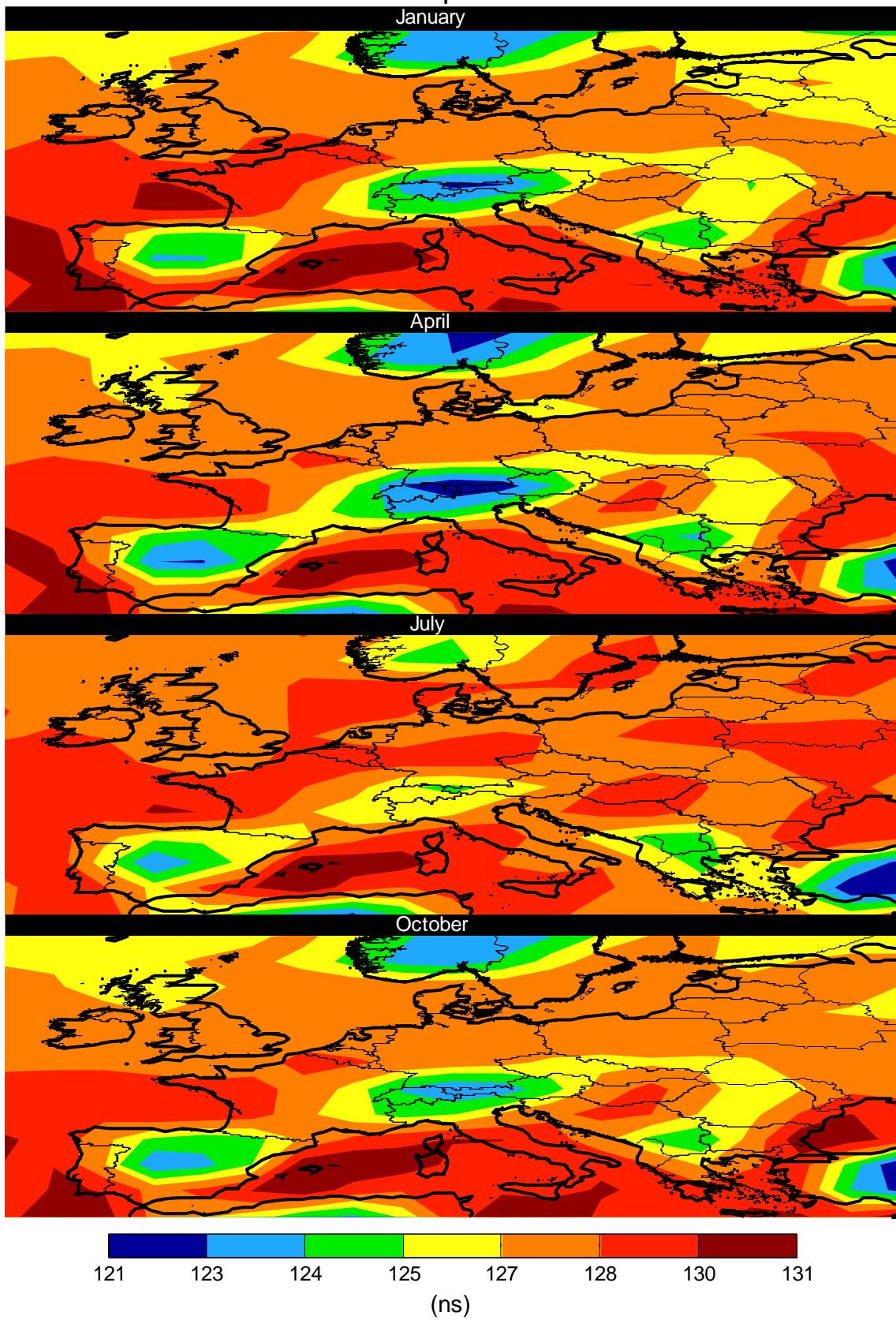
ECM 1991-2000 Time Delay 3° Elevation
Australia



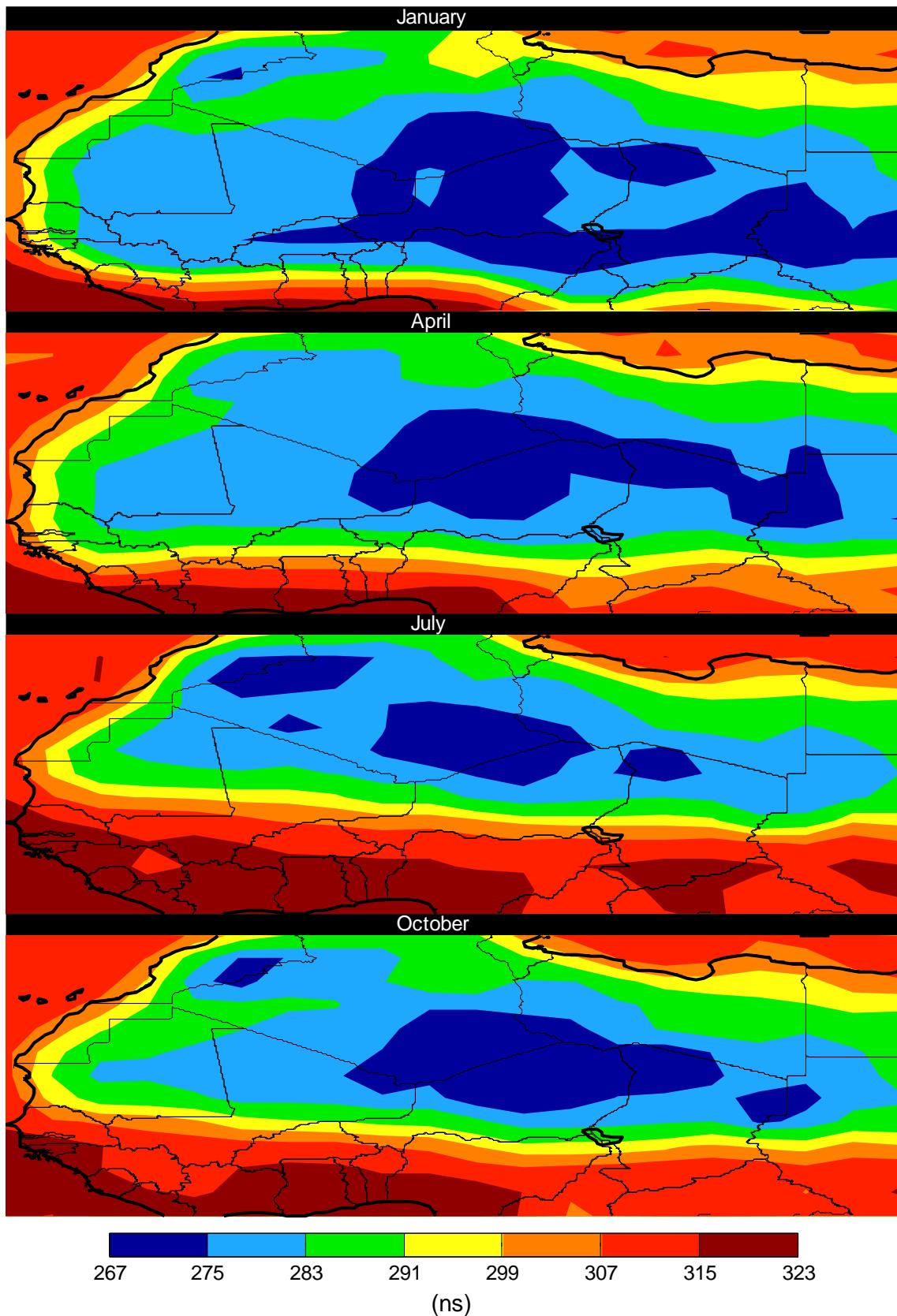
ECM 1991-2000 Time Delay 0° Elevation
Europe



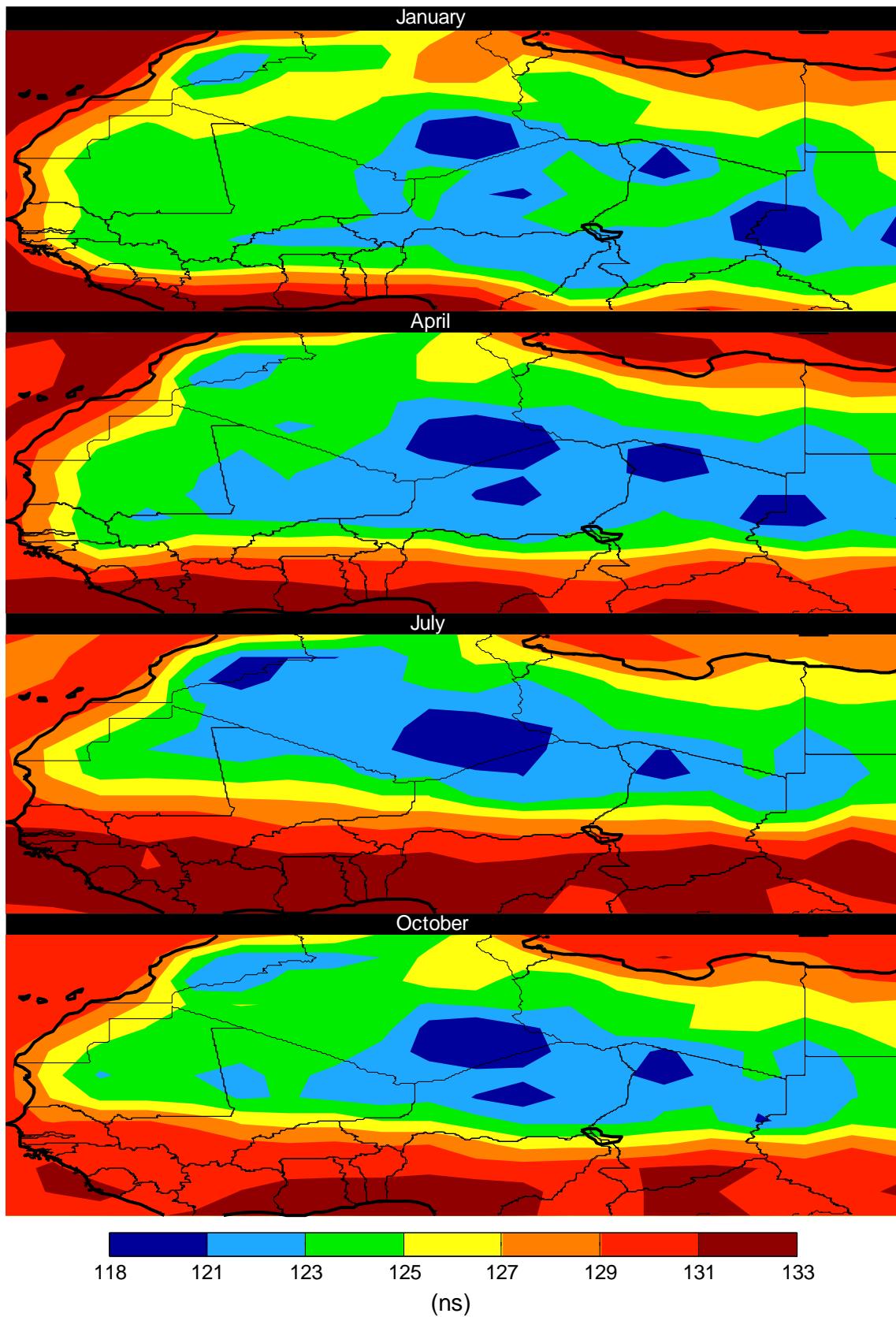
ECM 1991-2000 Time Delay 3° Elevation
Europe



ECM 1991-2000 Time Delay 0° Elevation
Sahara Desert



ECM 1991-2000 Time Delay 3° Elevation
Sahara Desert



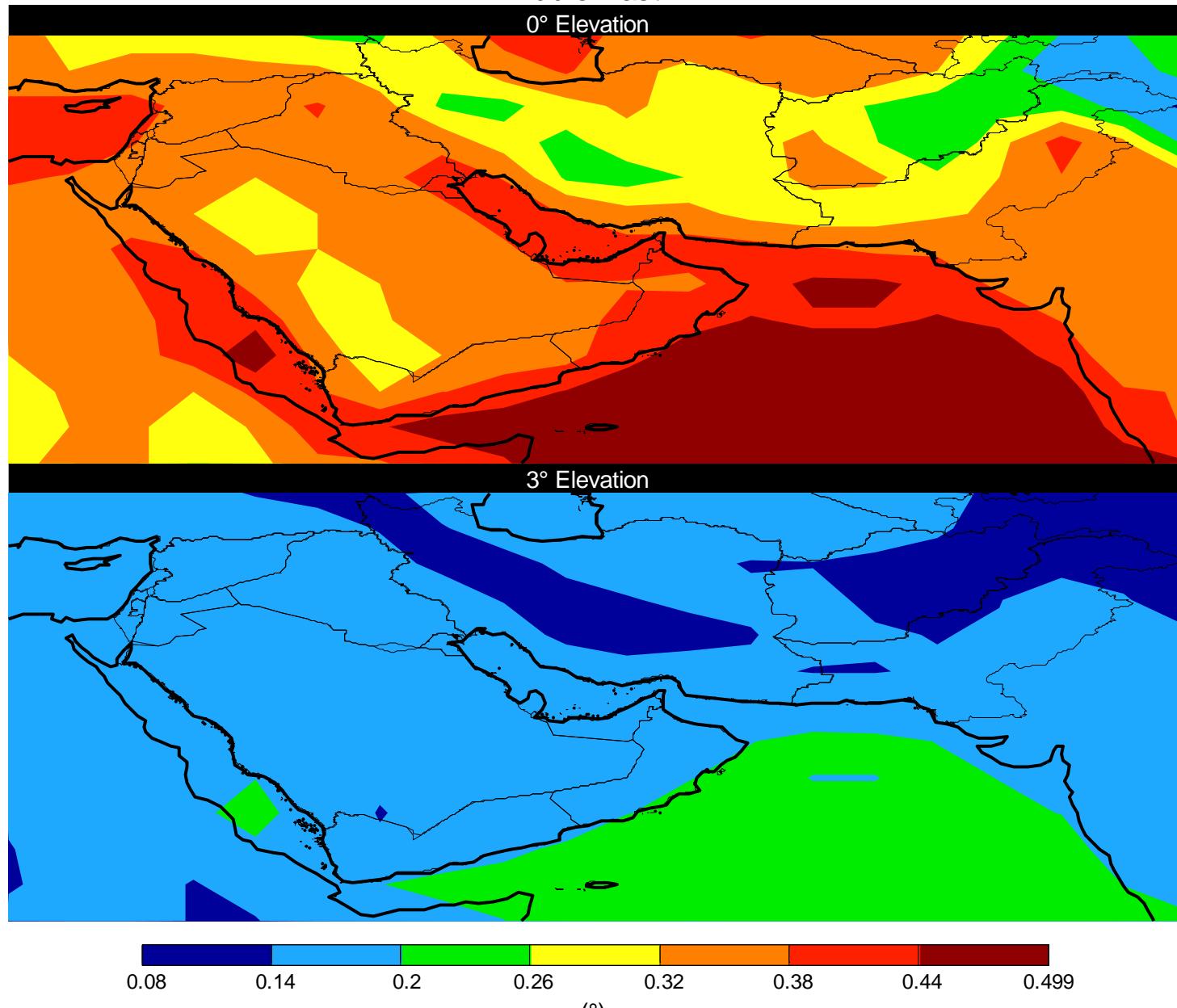
Appendix E

**ECM 1991-2000 ANGLE ERROR COMPARISON
JANUARY
0 AND 3° ELEVATION ANGLES**

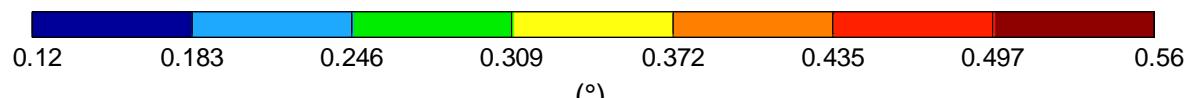
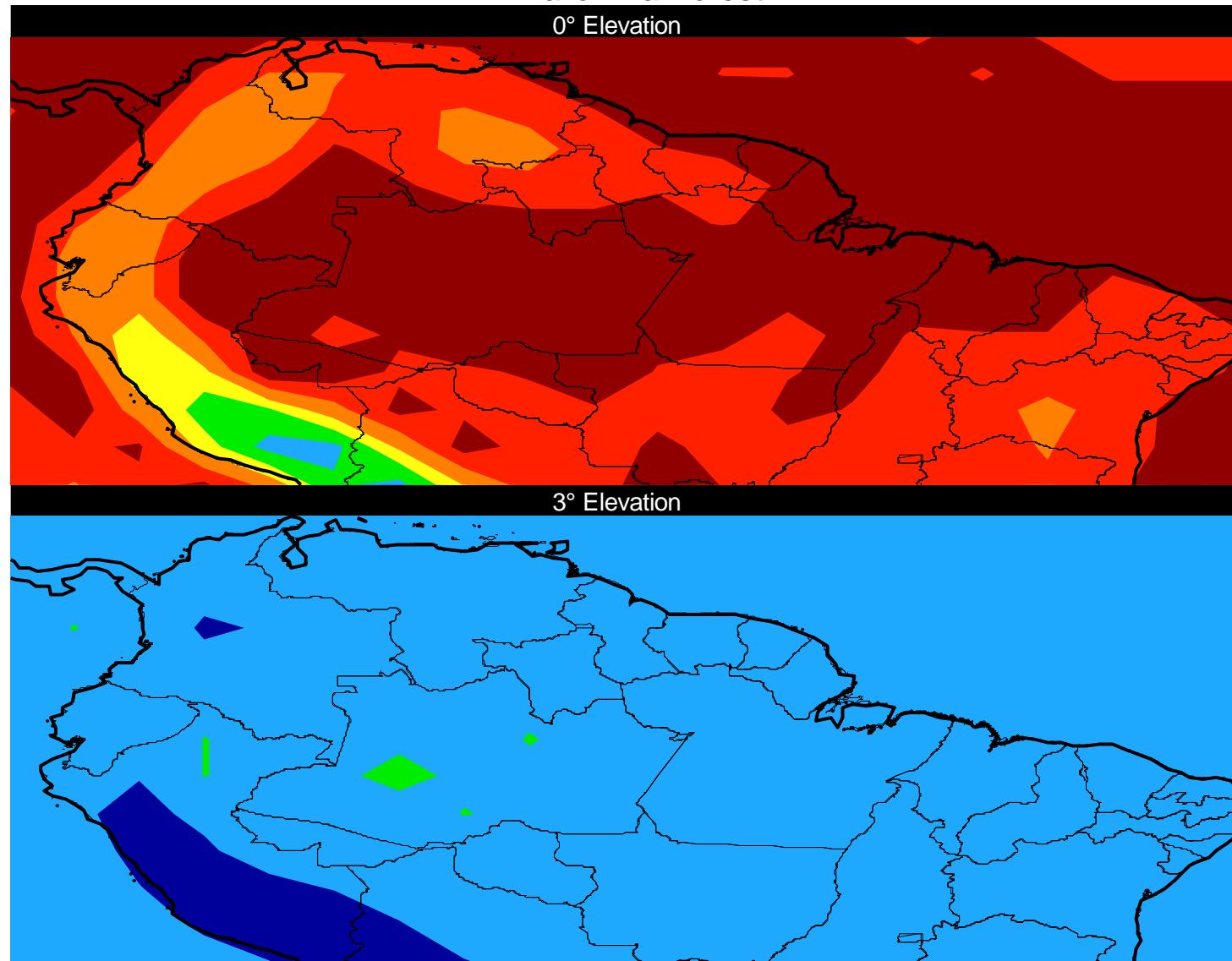
**ECM 1991-2000 TIME DELAY COMPARISON
JANUARY
0 AND 3° ELEVATION ANGLES
0 AND 5° ELEVATION ANGLES**

**MIDDLE EAST
AMAZON RAINFOREST
UNITED STATES**

ECM 1991-2000 Angle Error Comparison January 0 & 3°
Middle East



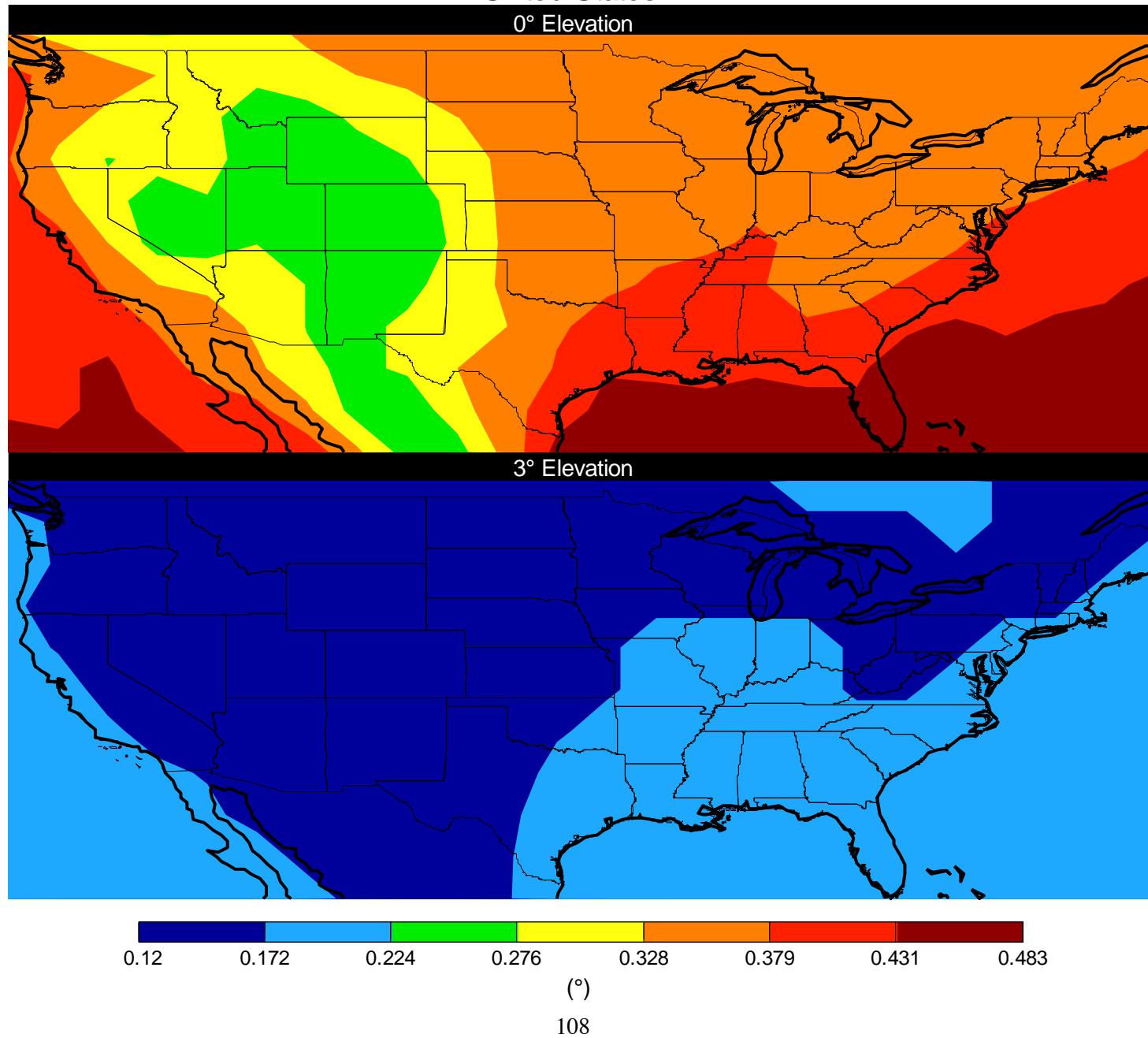
ECM 1991-2000 Angle Error Comparison January 0 & 3°
Amazon Rainforest



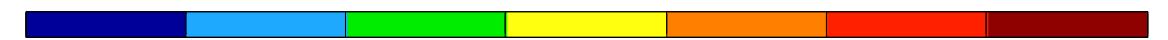
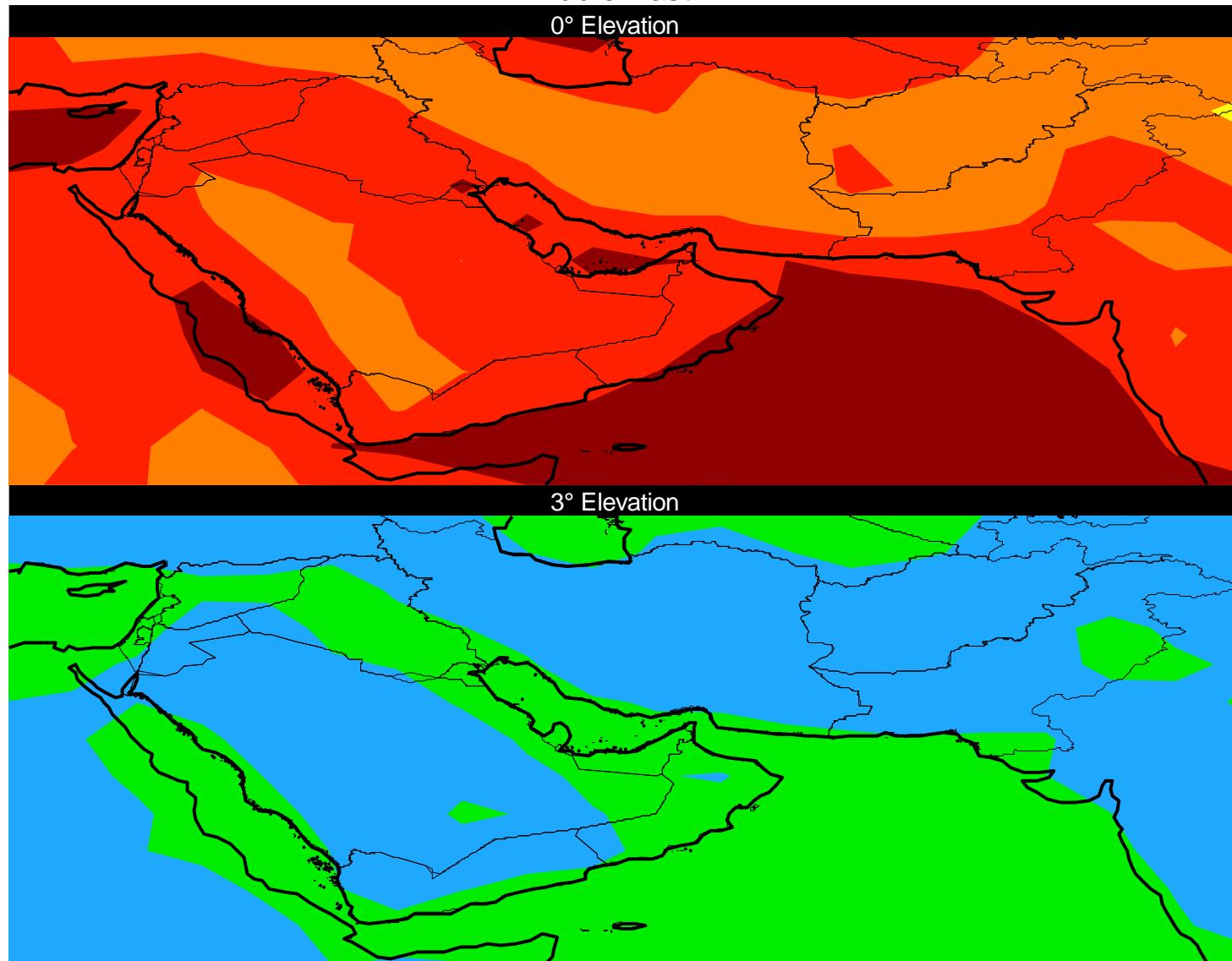
(°)

107

ECM 1991-2000 Angle Error Comparison January 0 & 3°
United States



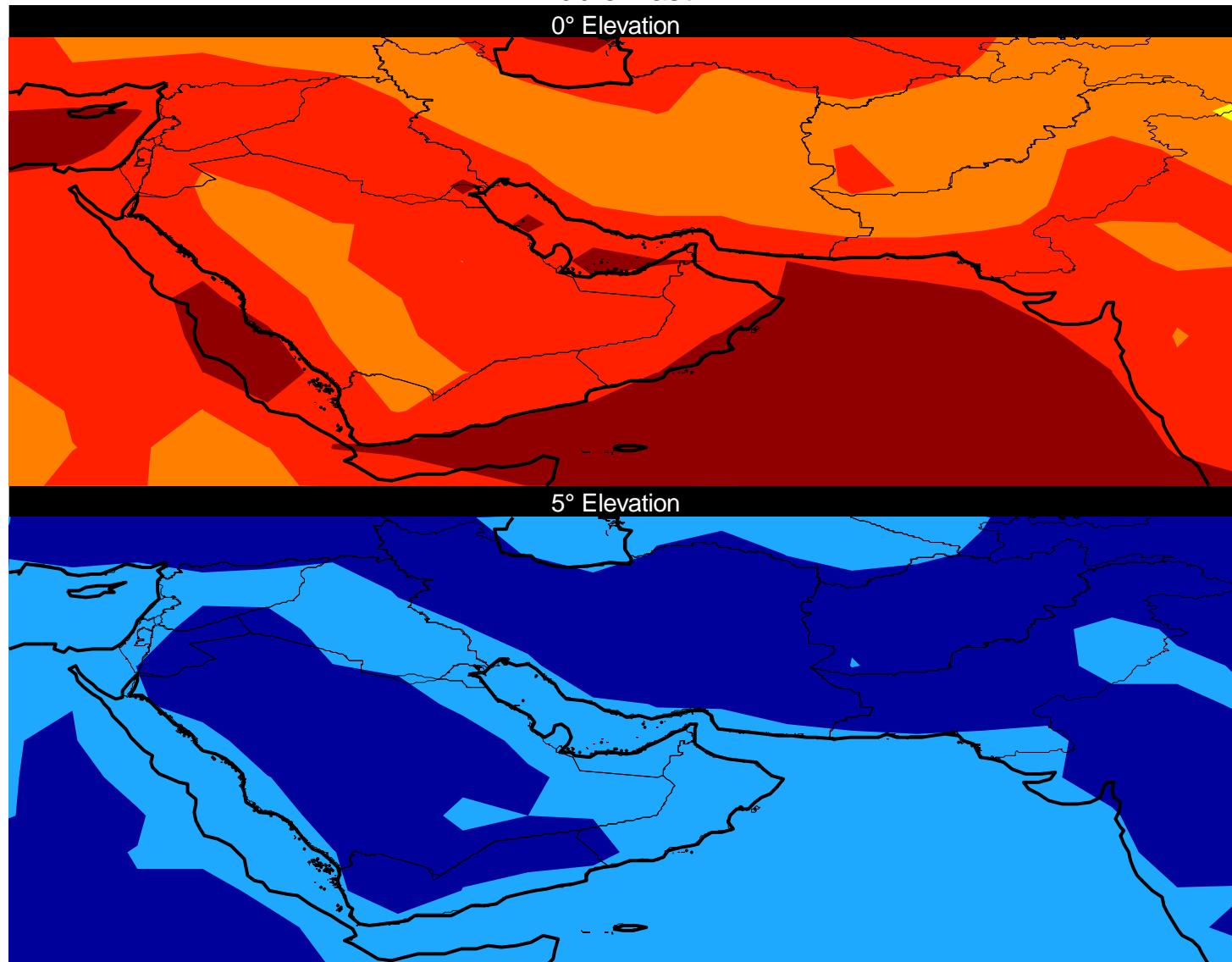
ECM 1991-2000 Time Delay Comparison January 0 & 3°
Middle East



(ns)

109

ECM 1991-2000 Time Delay Comparison January 0 & 5°
Middle East

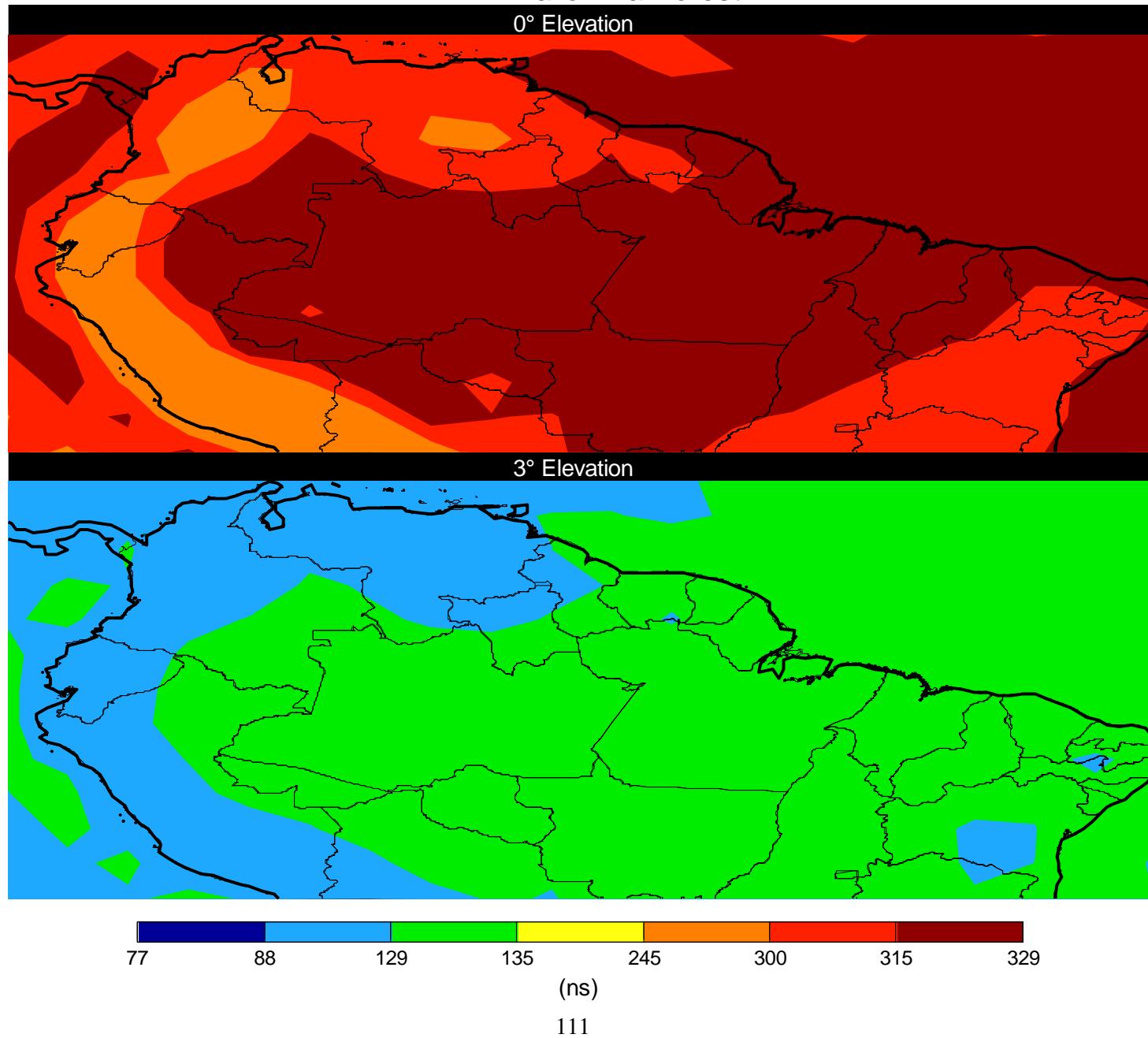


65 86 125 135 215 280 300 313

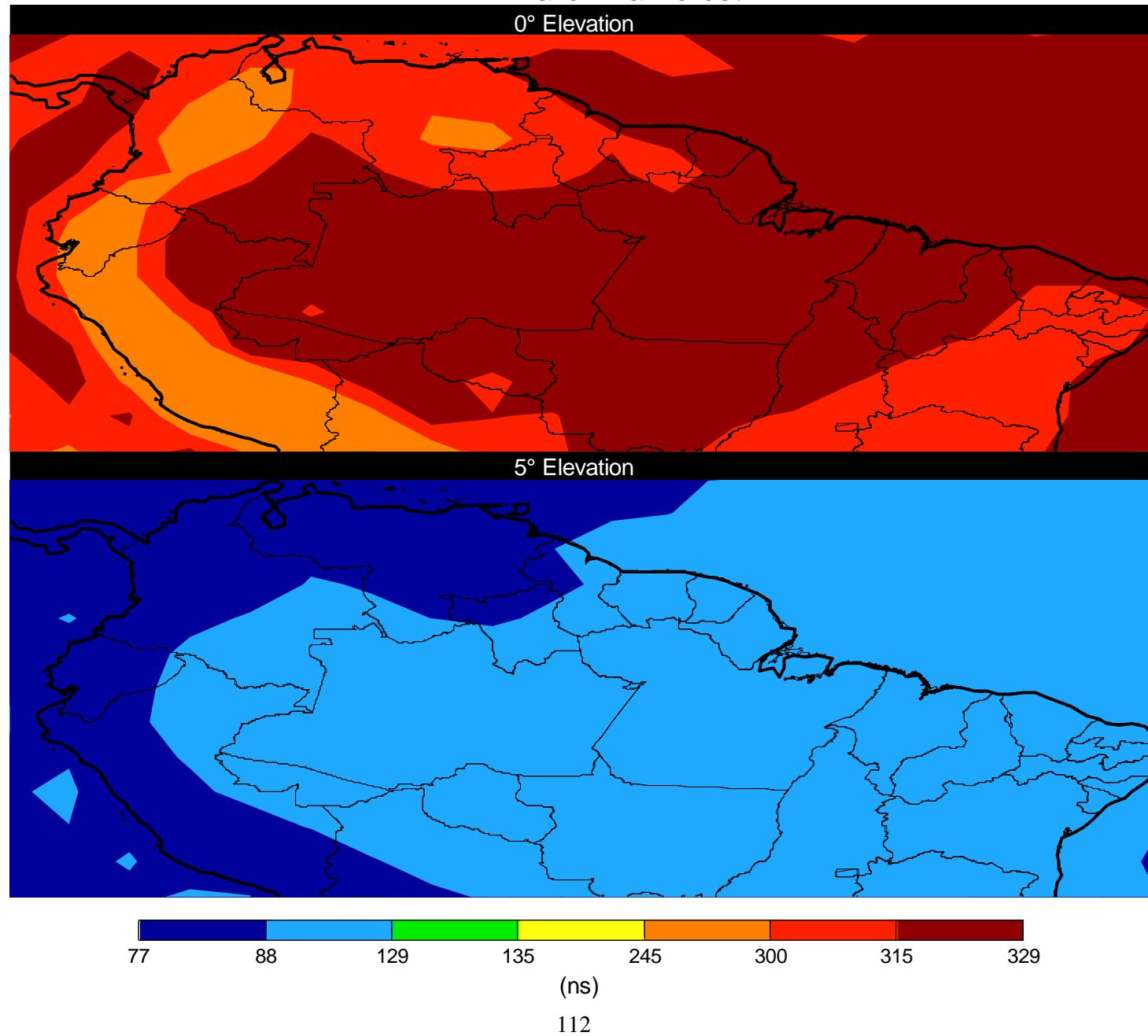
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110

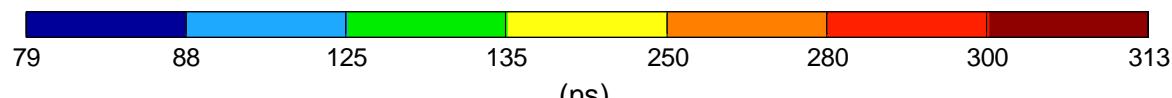
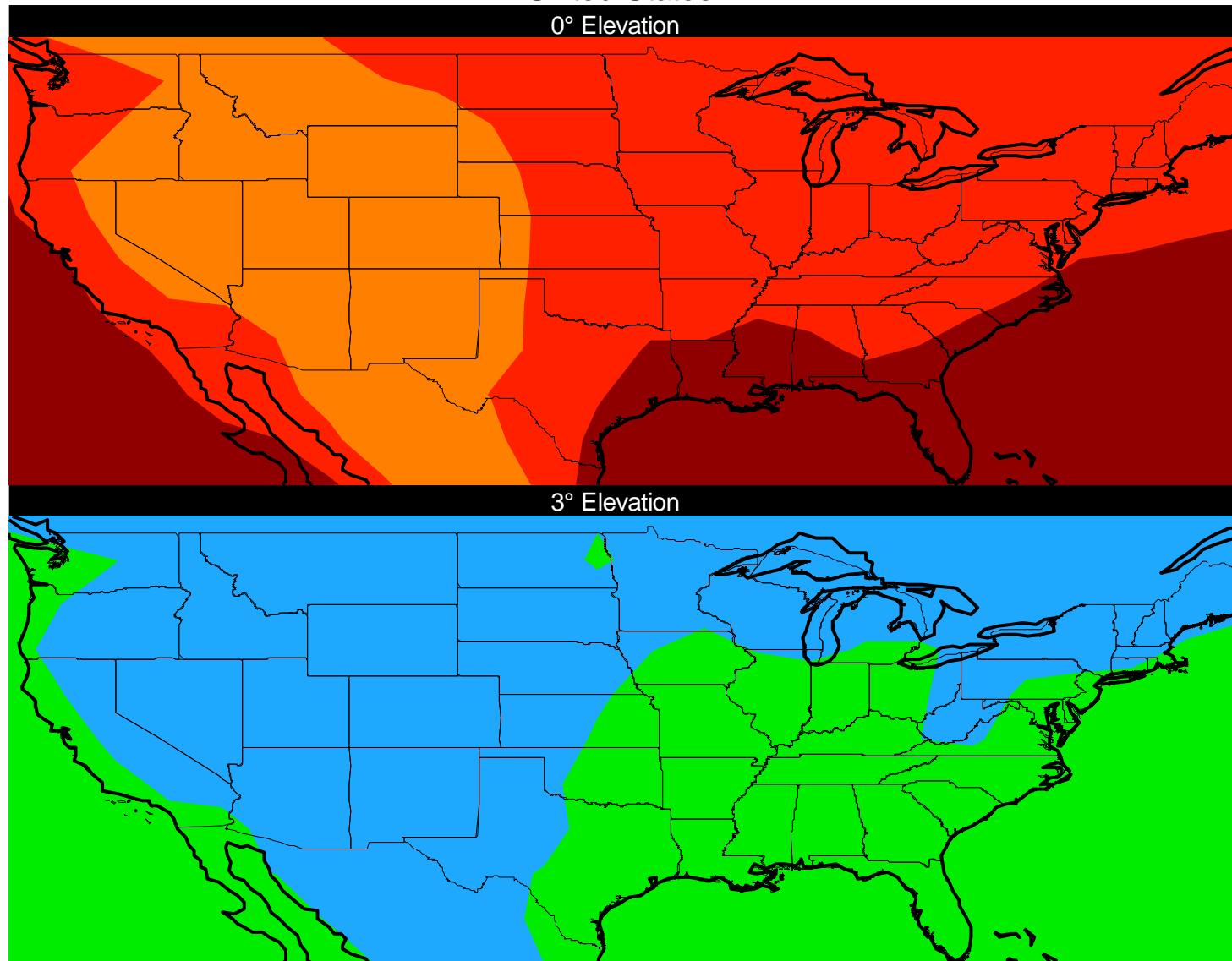
ECM 1991-2000 Time Delay Comparison January 0 & 3°
Amazon Rainforest



ECM 1991-2000 Time Delay Comparison January 0 & 5°
Amazon Rainforest

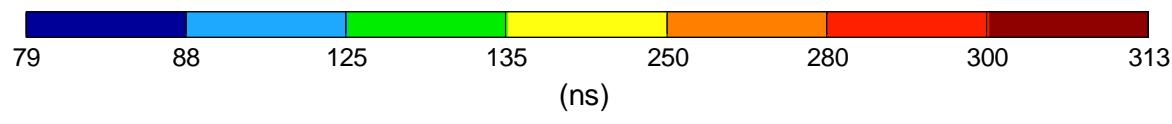
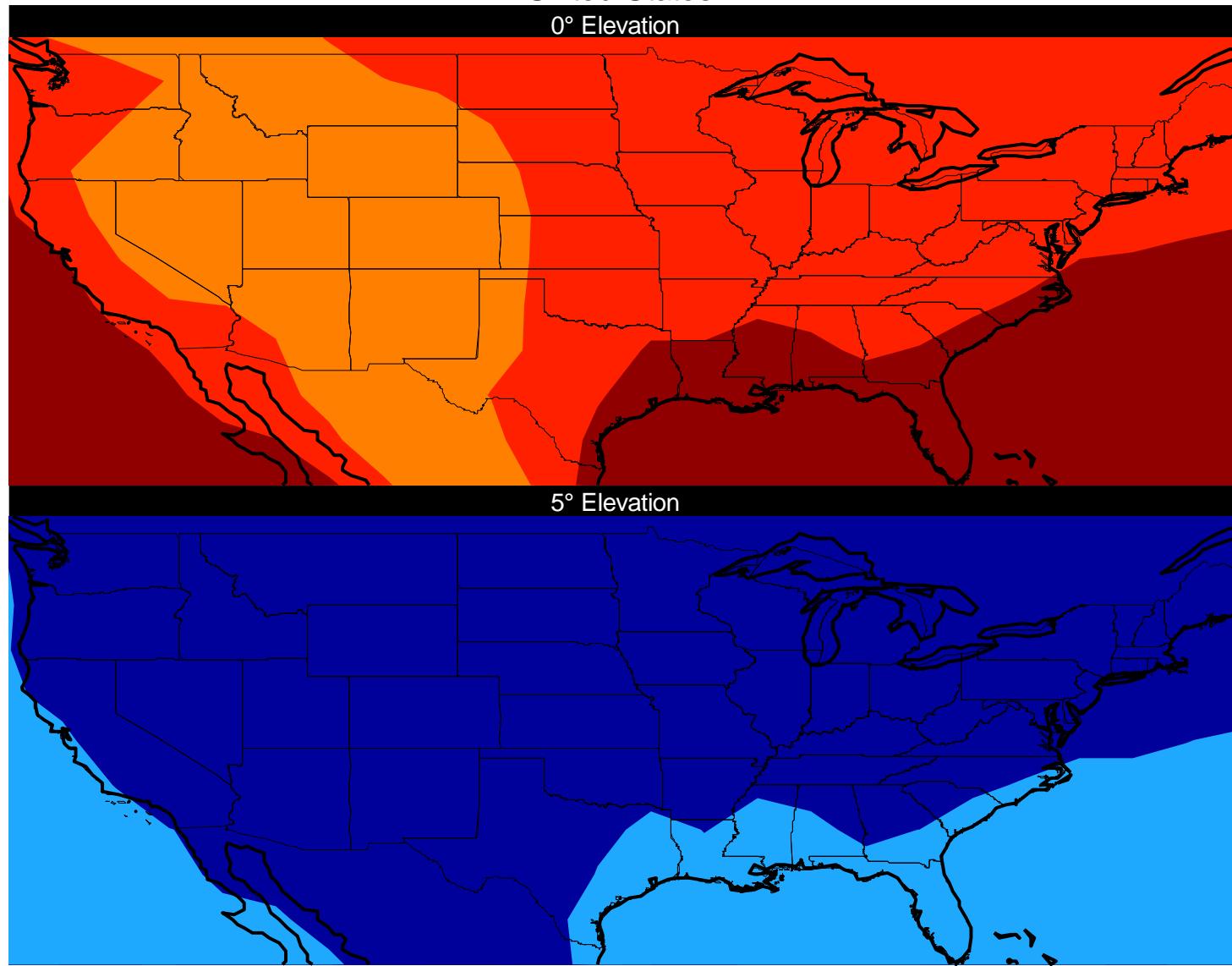


ECM 1991-2000 Time Delay Comparison January 0 & 3°
United States



113

ECM 1991-2000 Time Delay Comparison January 0 & 5°
United States

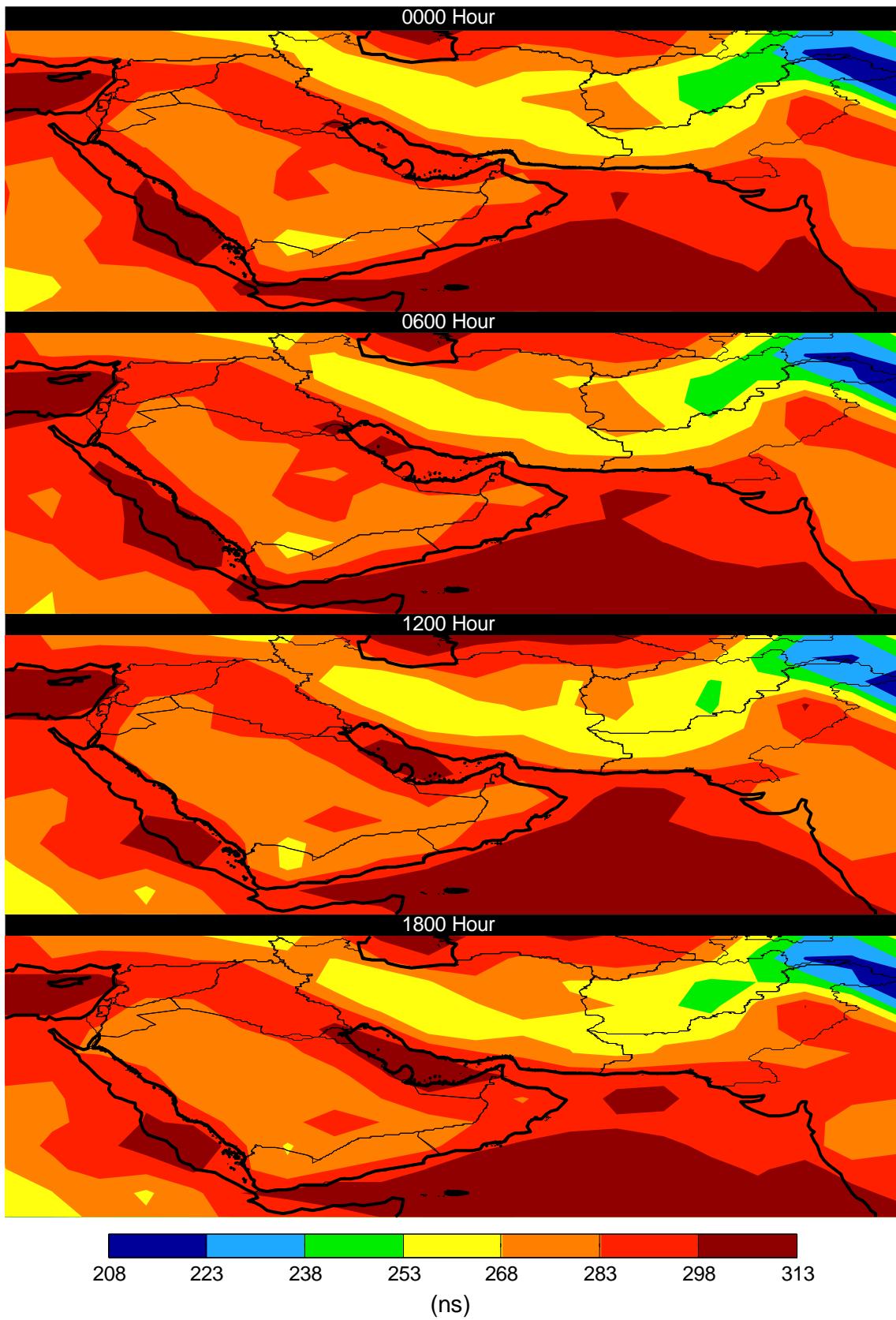


Appendix F

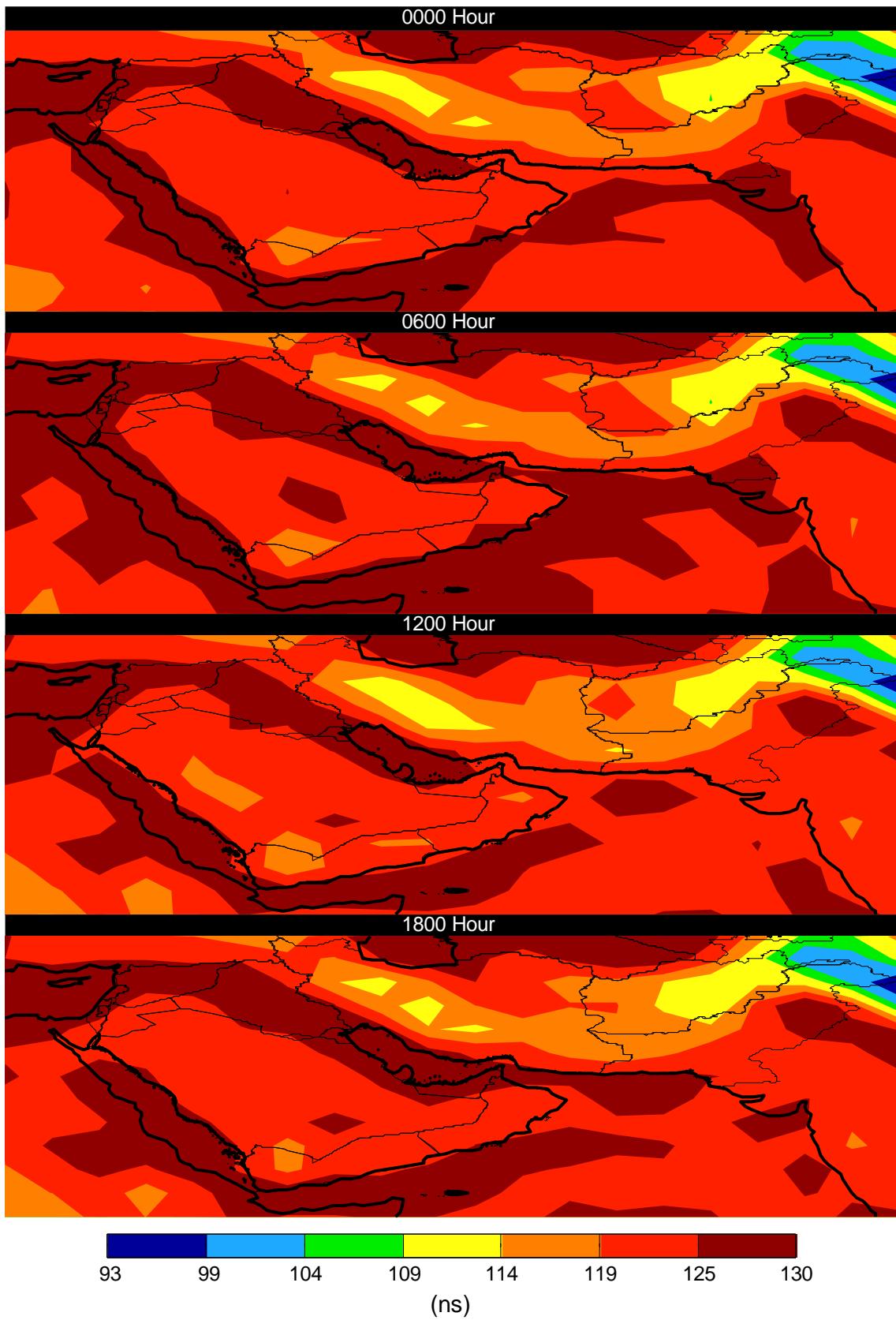
**MRF TIME DELAYS
JANUARY AND JULY 1 AND 15, 2003
0000, 0600, 1200, AND 1800 HOURS
0, 3, AND 5° ELEVATION ANGLES**

MIDDLE EAST

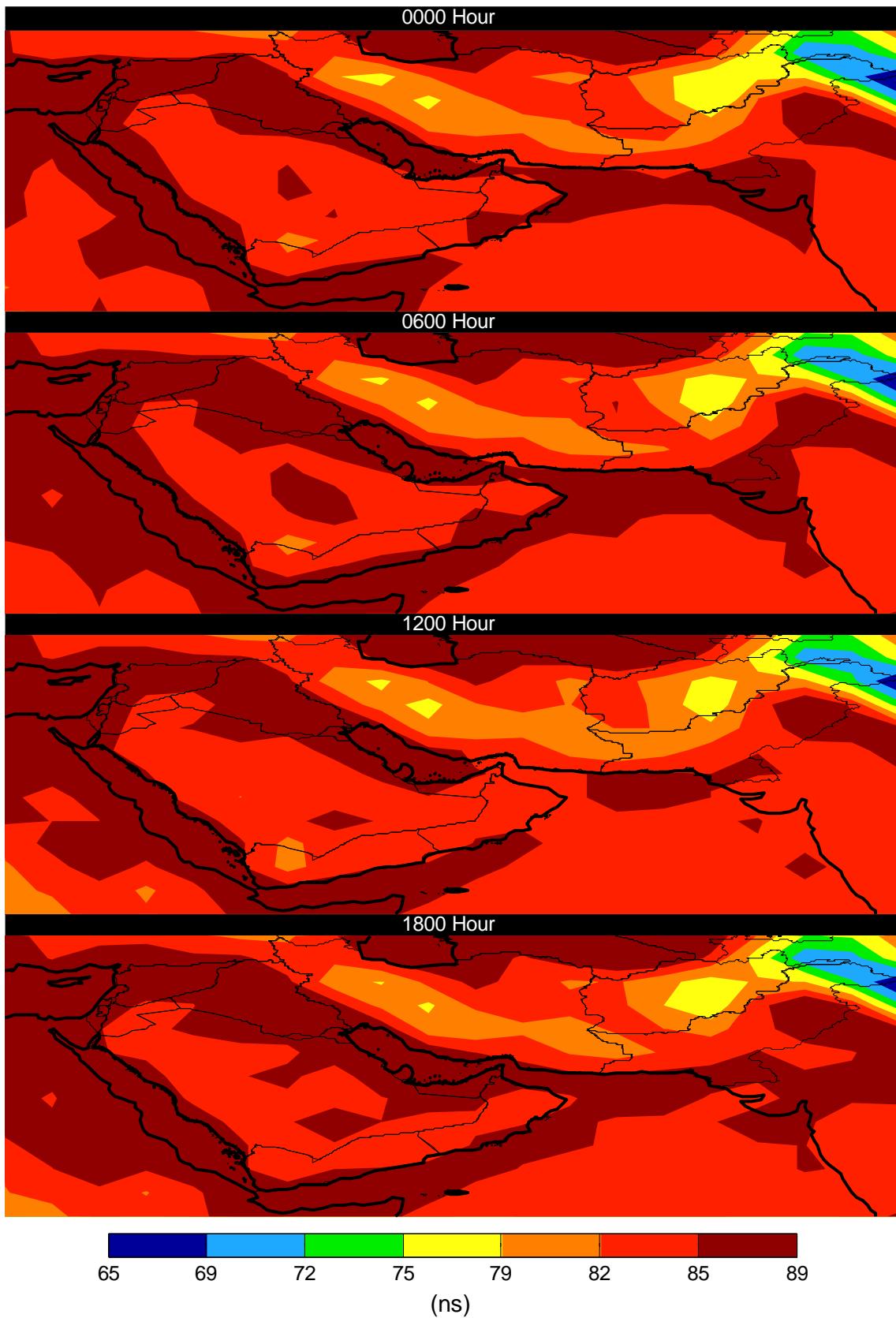
MRF Time Delay JAN 01 2003 0° Elevation
Middle East



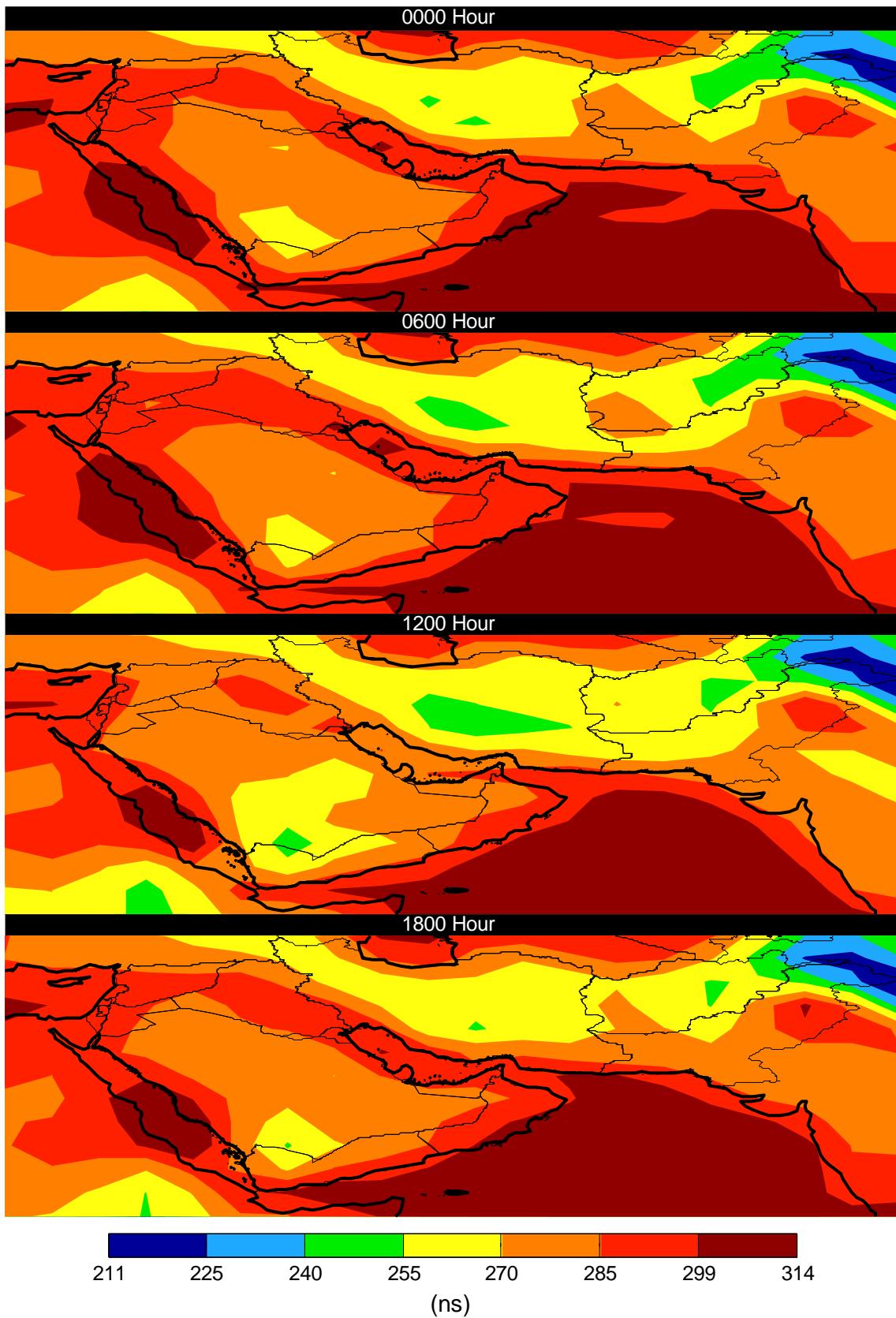
MRF Time Delay JAN 01 2003 3° Elevation
Middle East



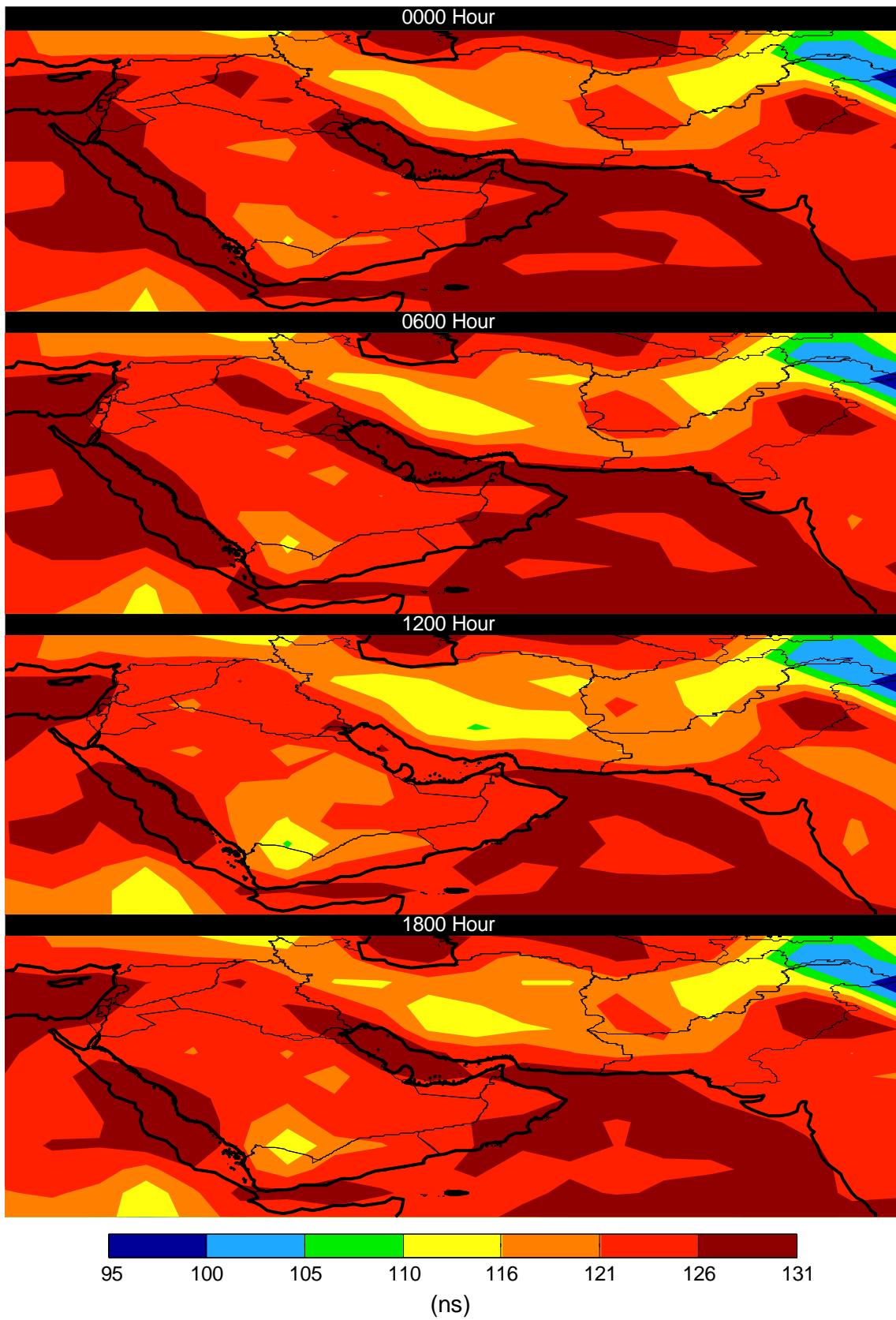
MRF Time Delay JAN 01 2003 5° Elevation
Middle East



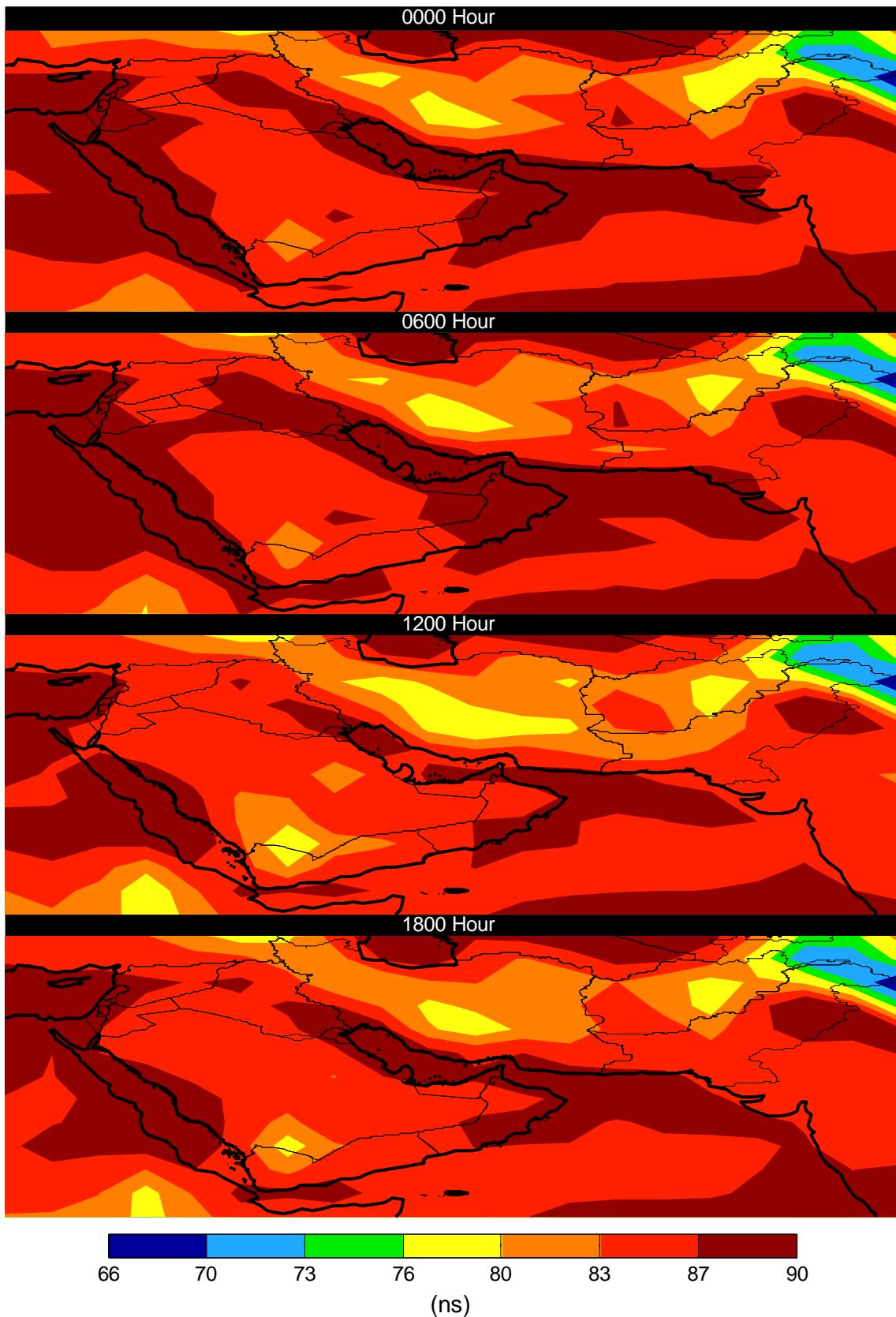
MRF Time Delay JAN 15 2003 0° Elevation
Middle East



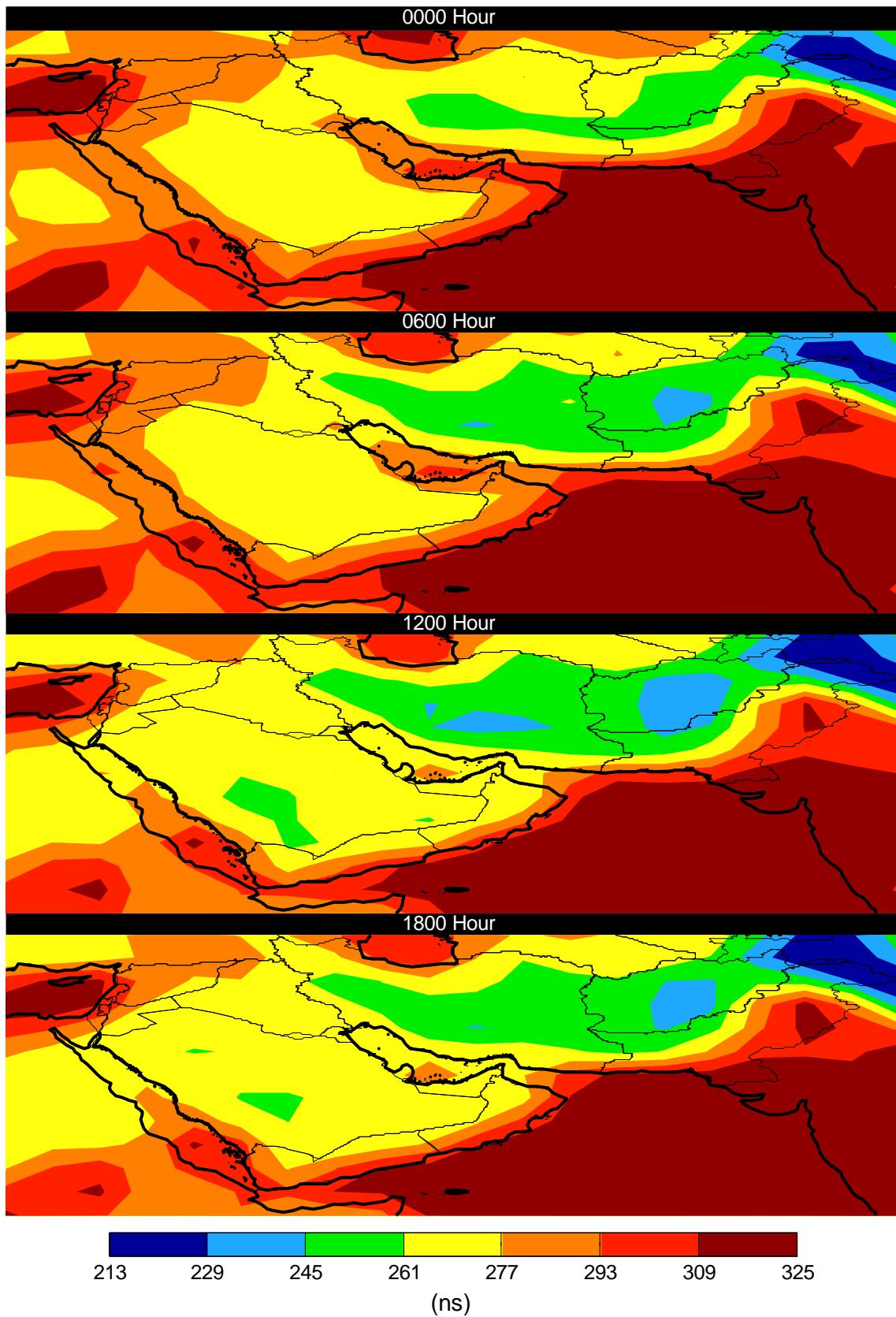
MRF Time Delay JAN 15 2003 3° Elevation
Middle East



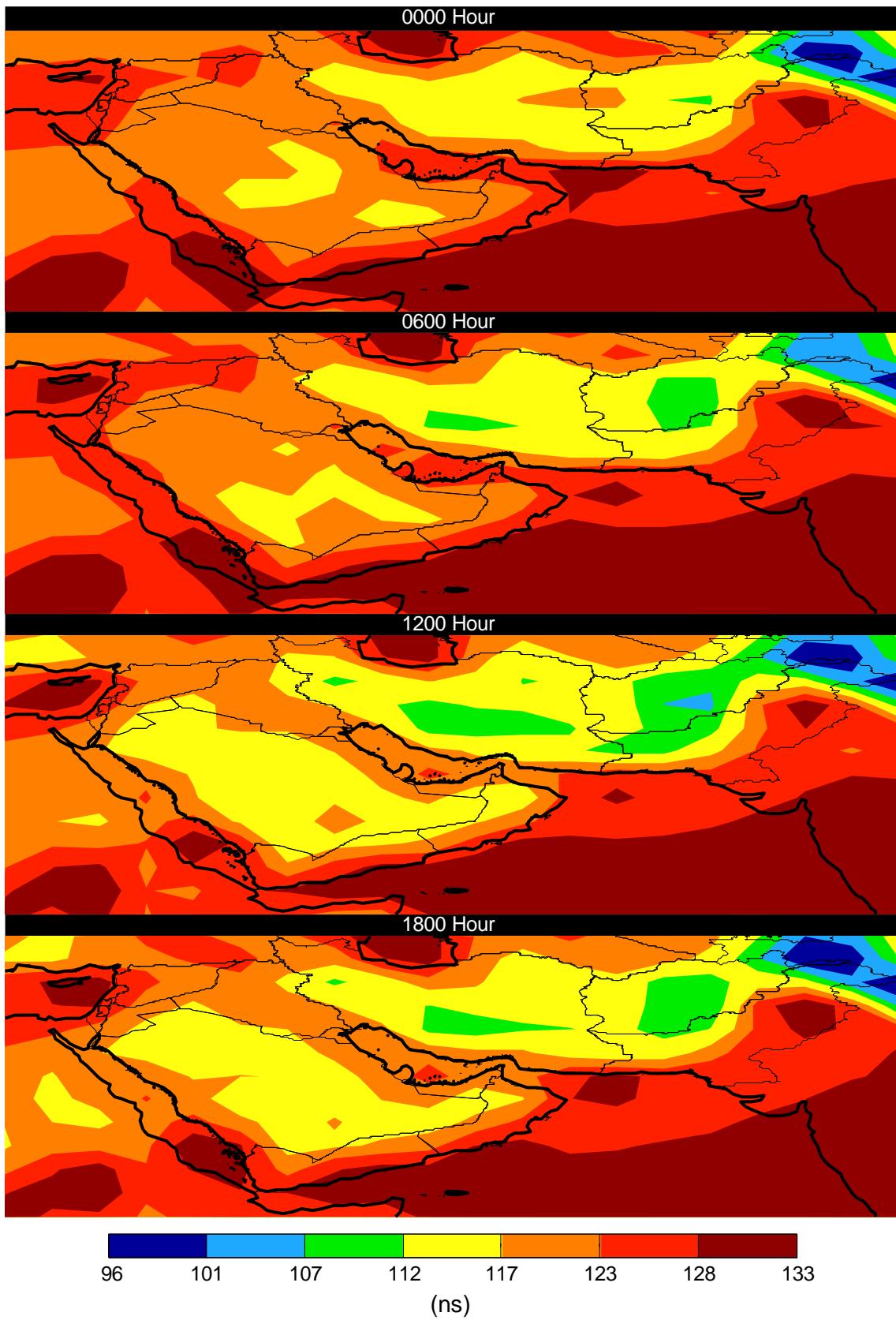
MRF Time Delay JAN 15 2003 5° Elevation
Middle East



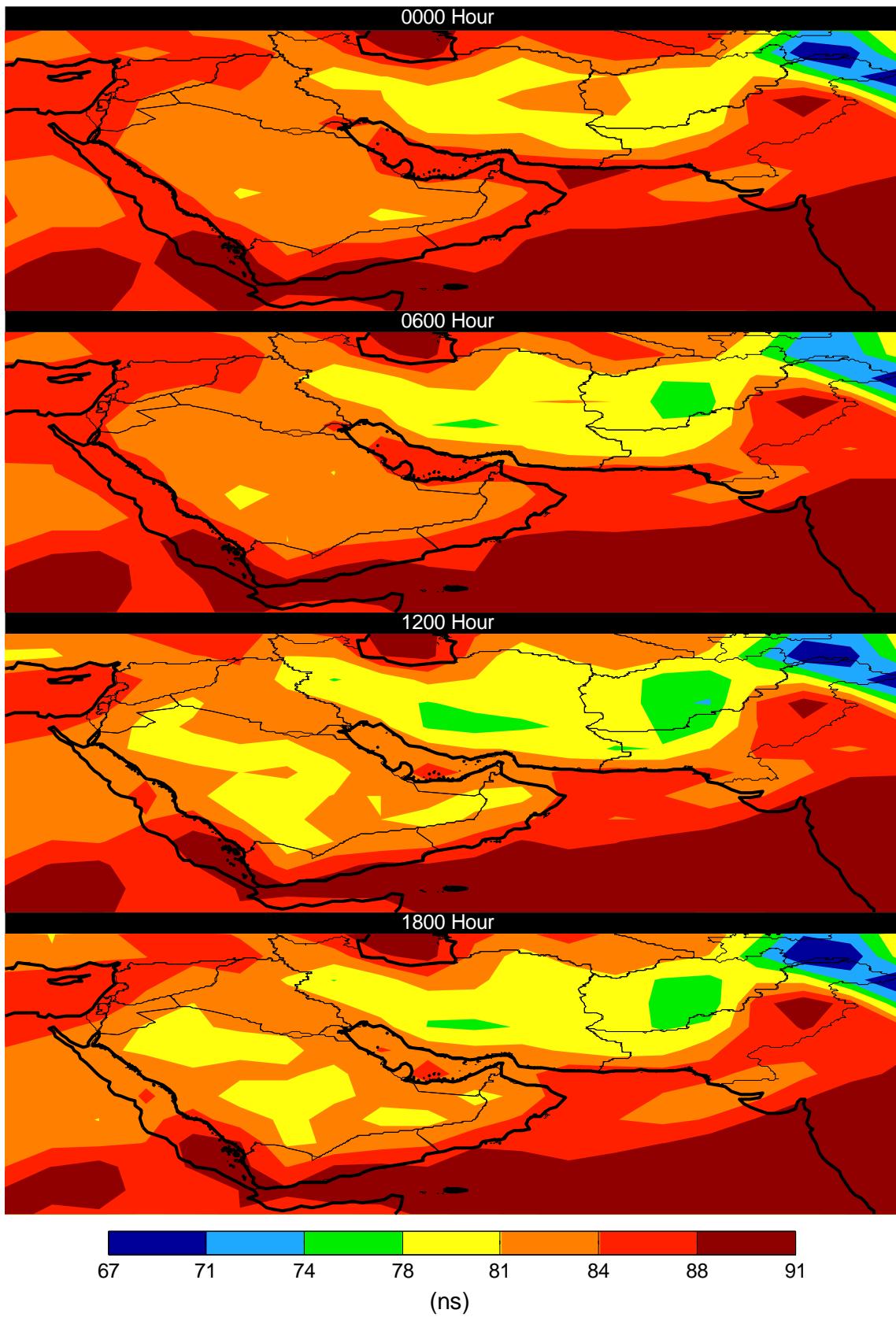
MRF Time Delay JUL 01 2003 0° Elevation
Middle East



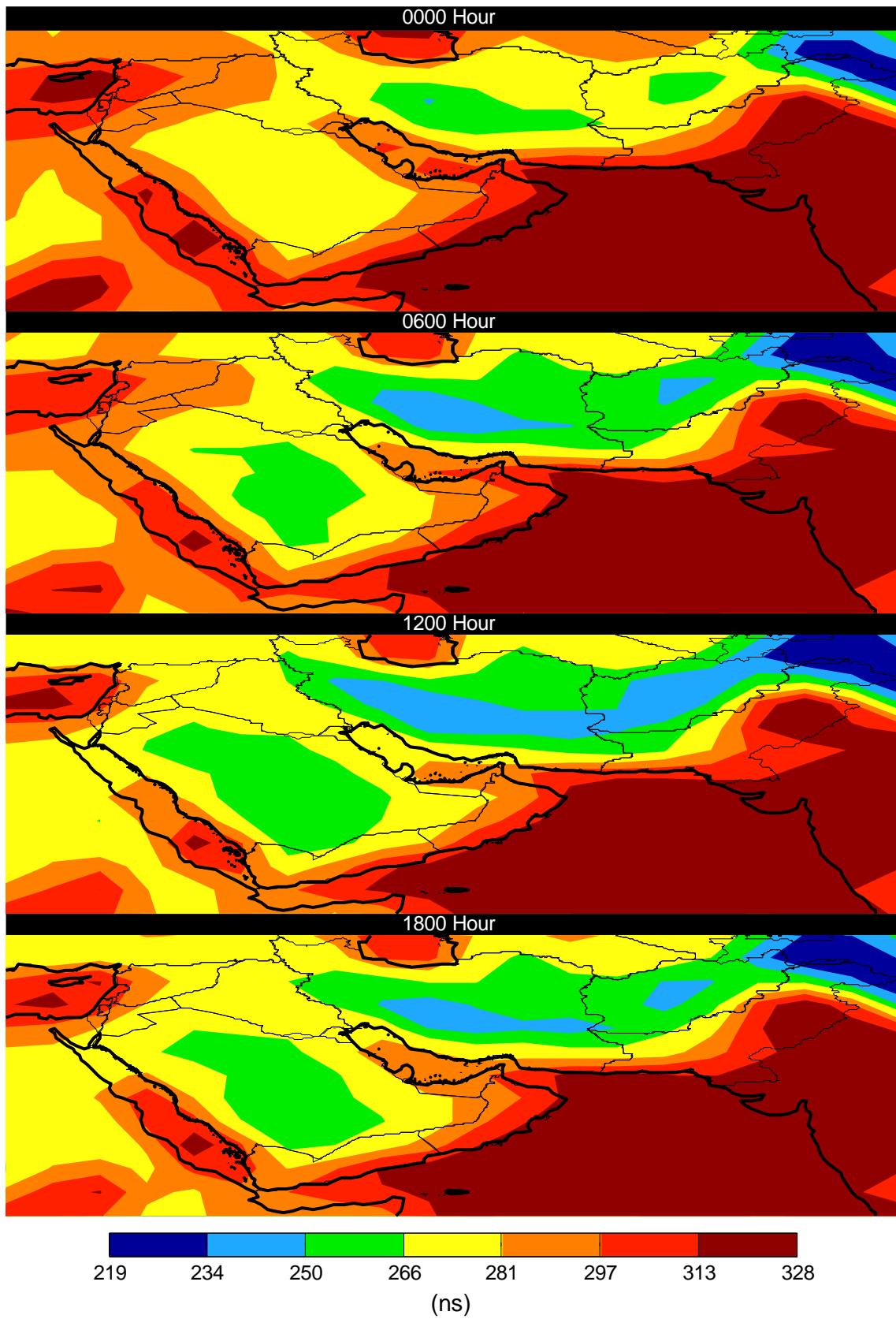
MRF Time Delay JUL 01 2003 3° Elevation
Middle East



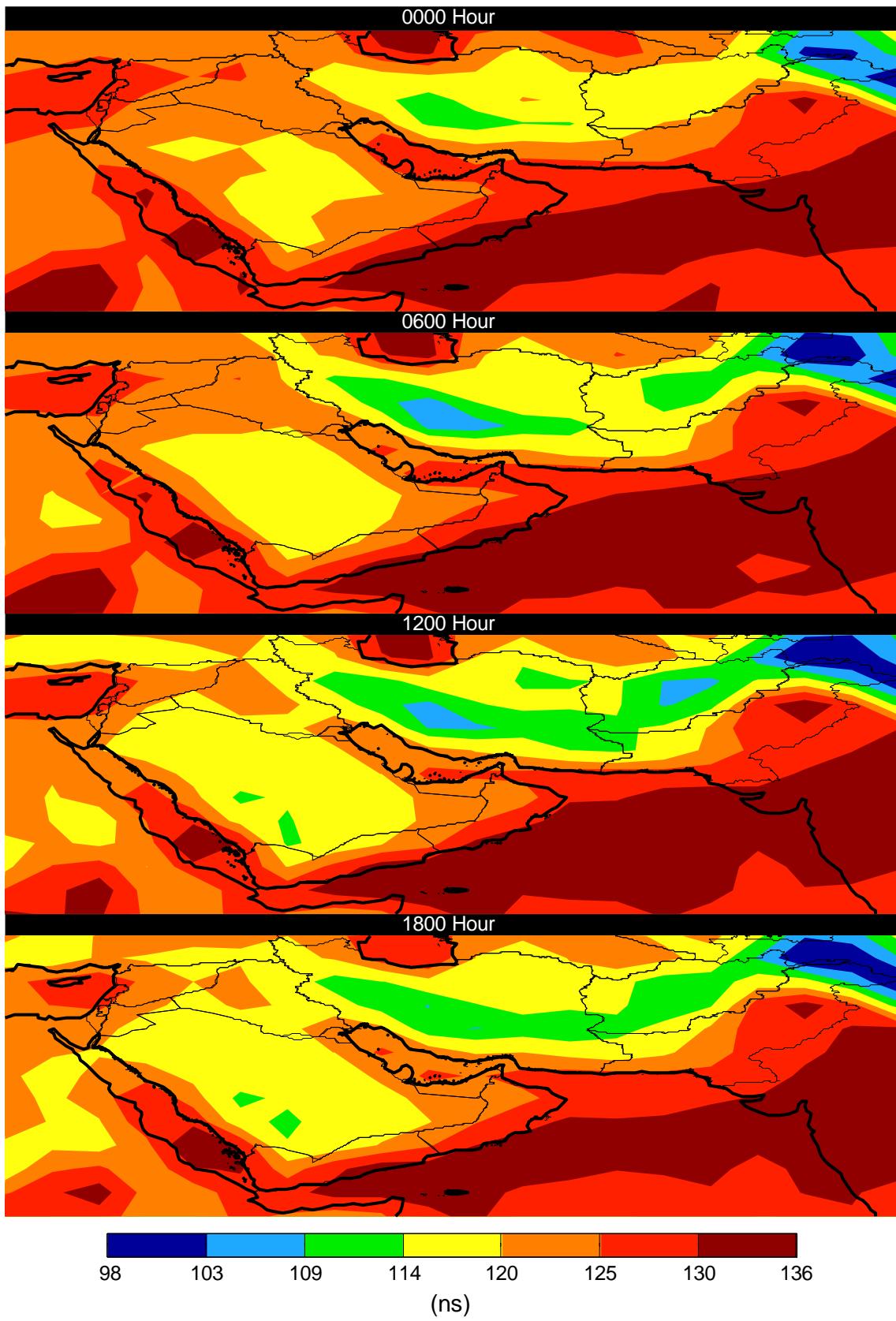
MRF Time Delay JUL 01 2003 5° Elevation
Middle East



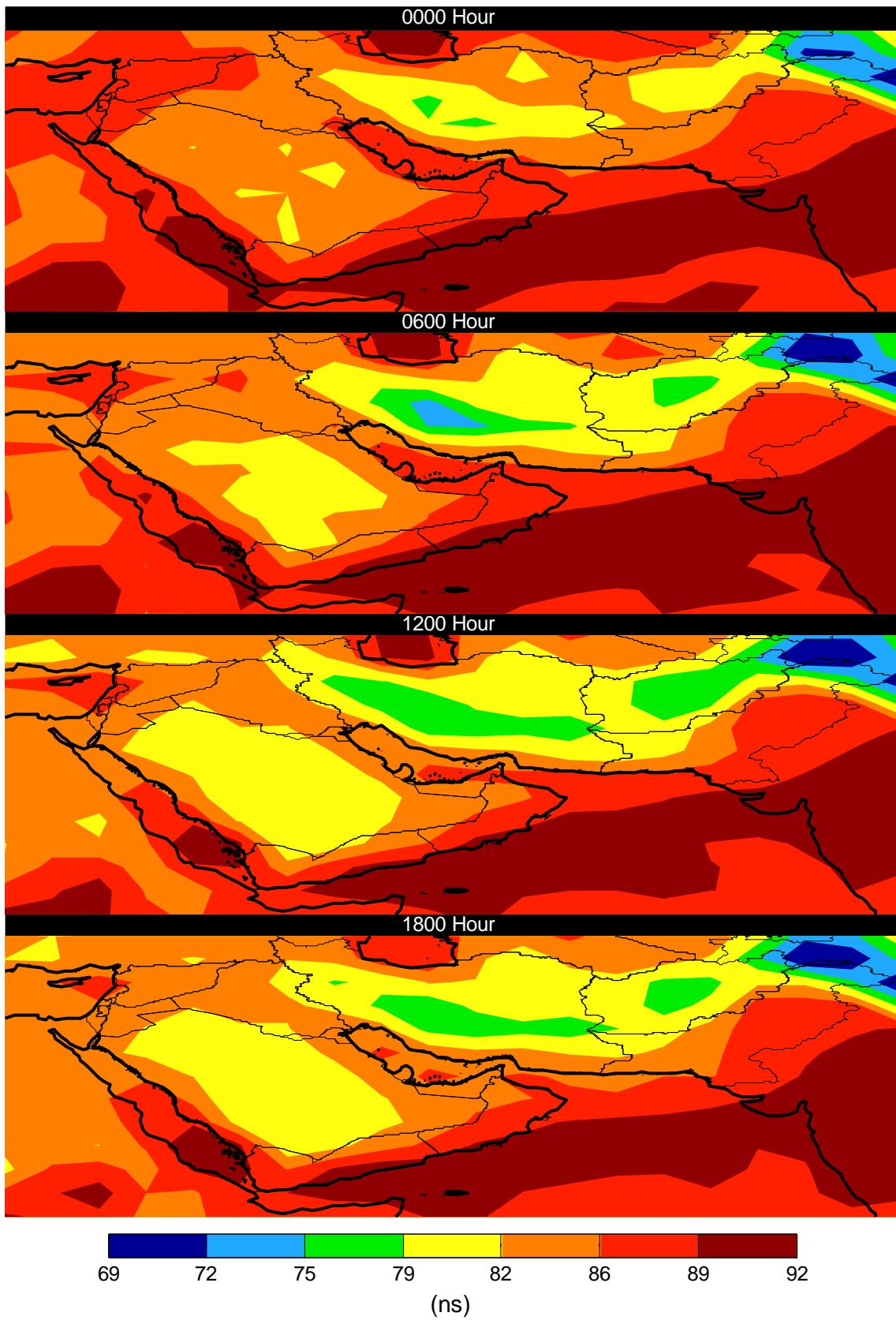
MRF Time Delay JUL 15 2003 0° Elevation
Middle East



MRF Time Delay JUL 15 2003 3° Elevation
Middle East



MRF Time Delay JUL 15 2003 5° Elevation
Middle East

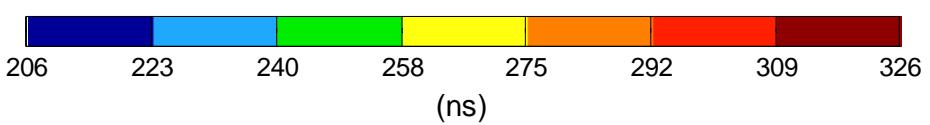
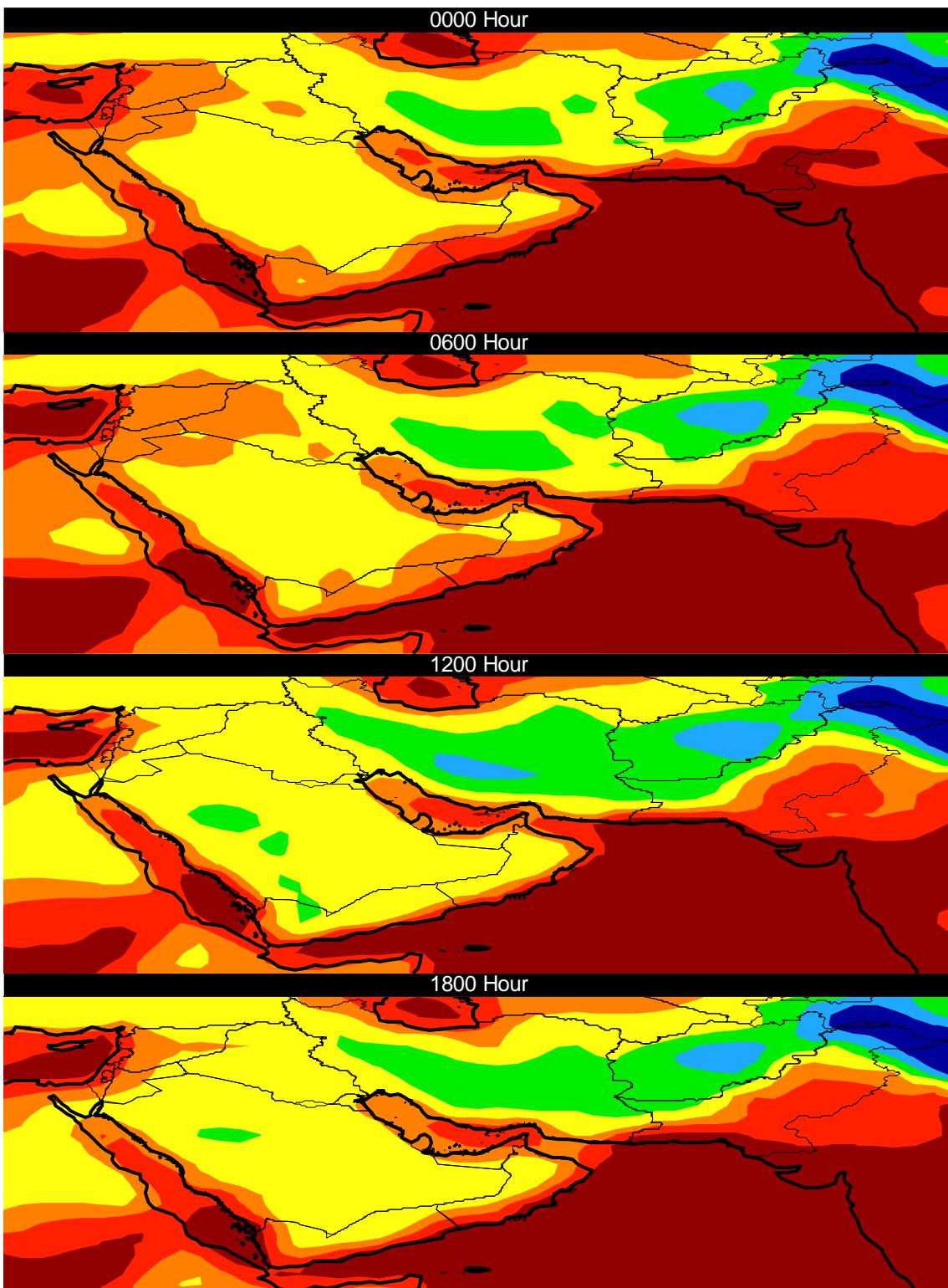


Appendix G

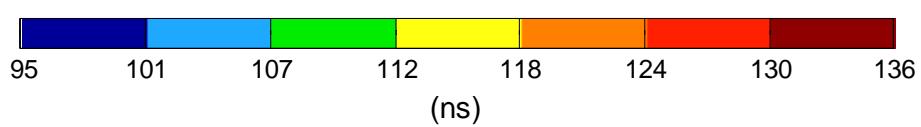
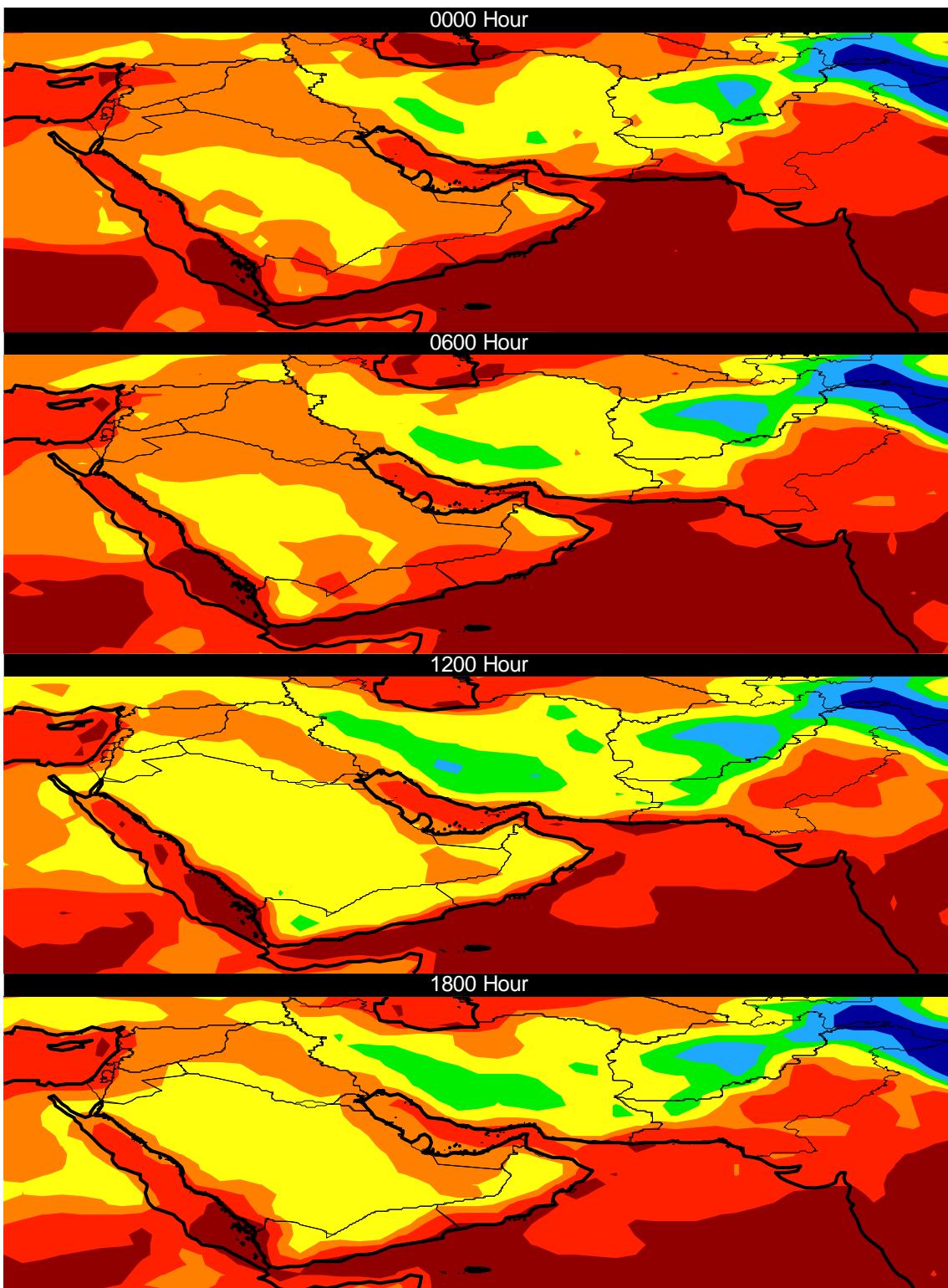
**FNL TIME DELAYS
JULY 1 AND 15, 2003
0000, 0600, 1200, AND 1800 HOURS
0, 3, AND 5° ELEVATION ANGLES**

MIDDLE EAST

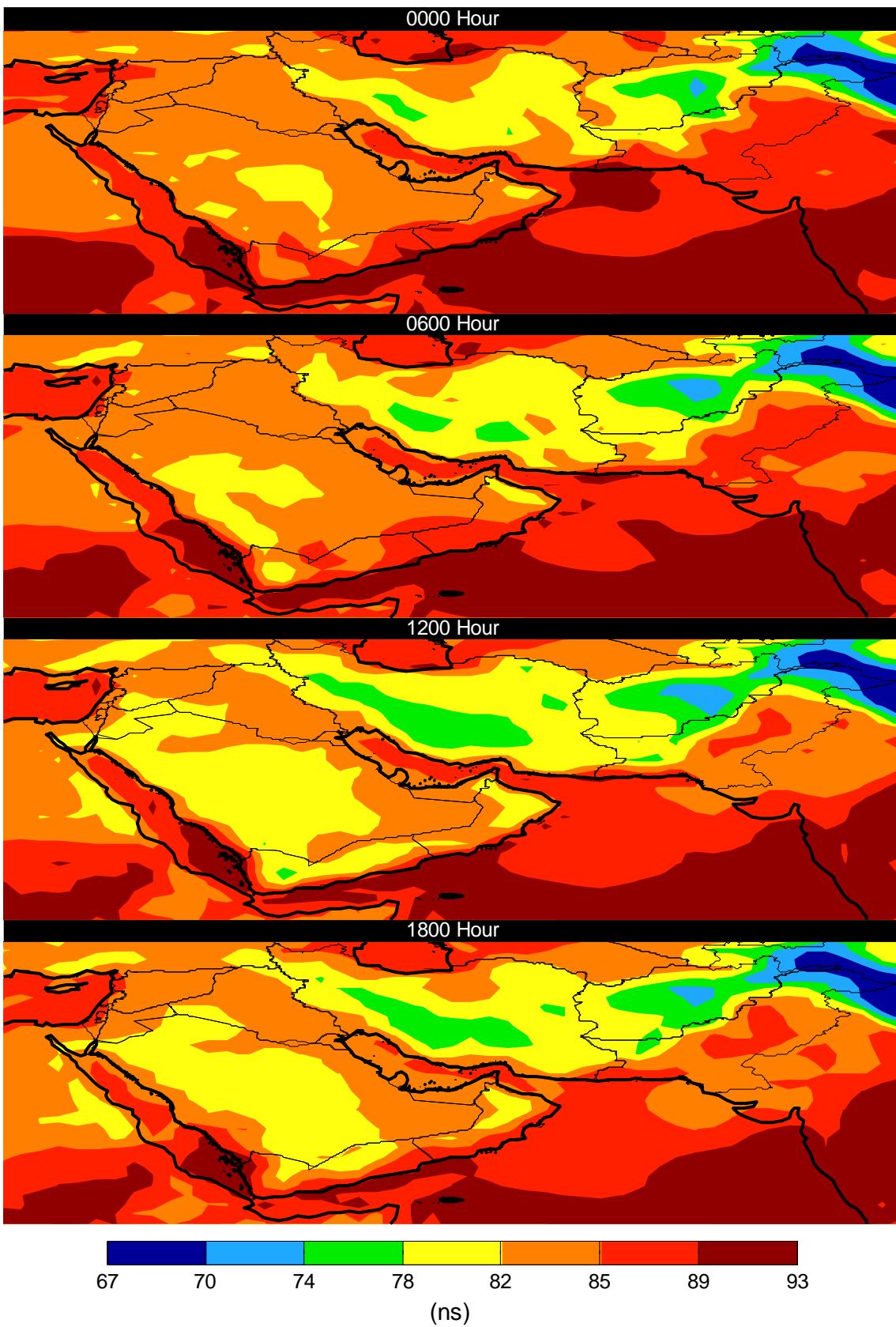
FNL Time Delay JUL 01 2003 0° Elevation
Middle East



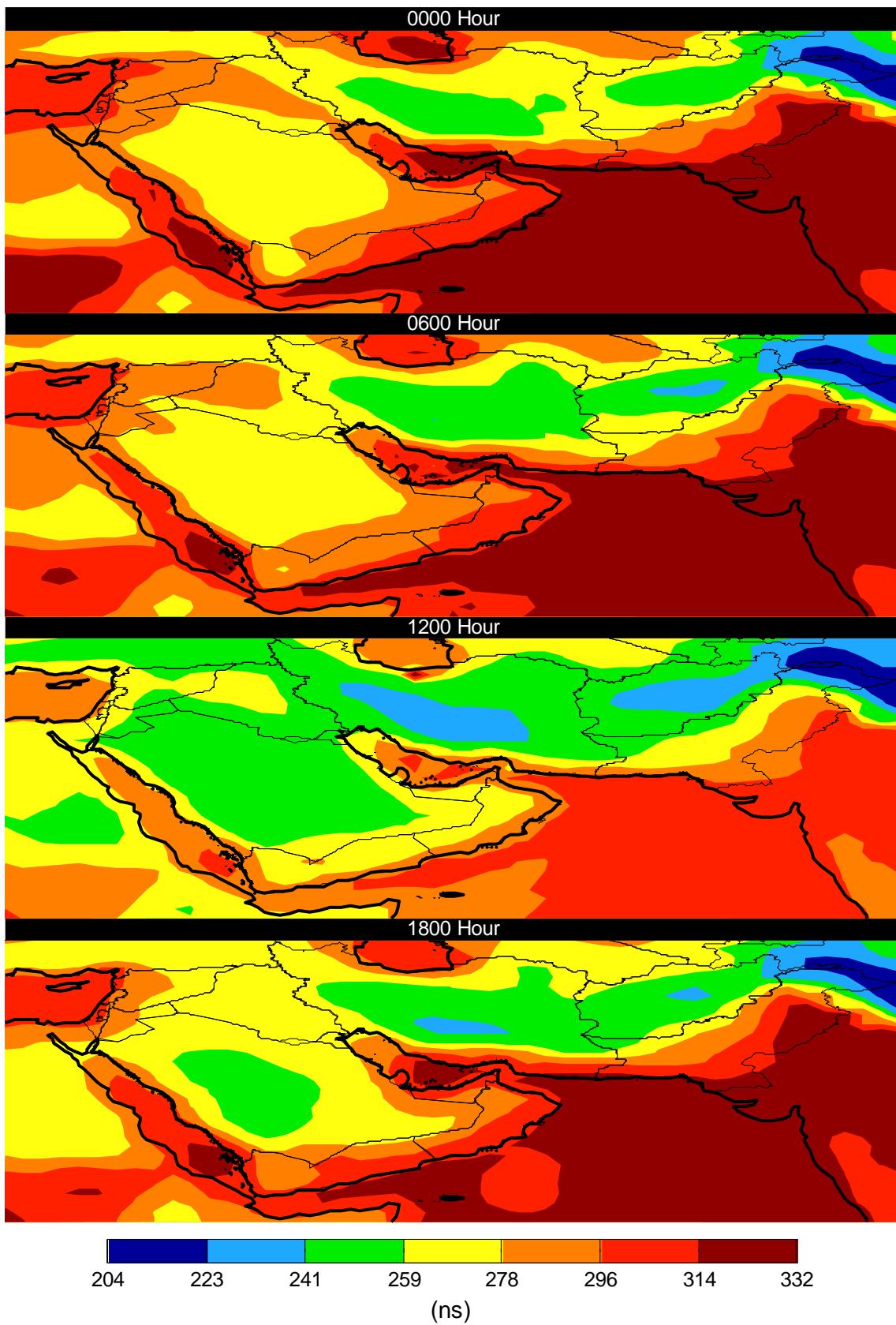
FNL Time Delay JUL 01 2003 3° Elevation
Middle East



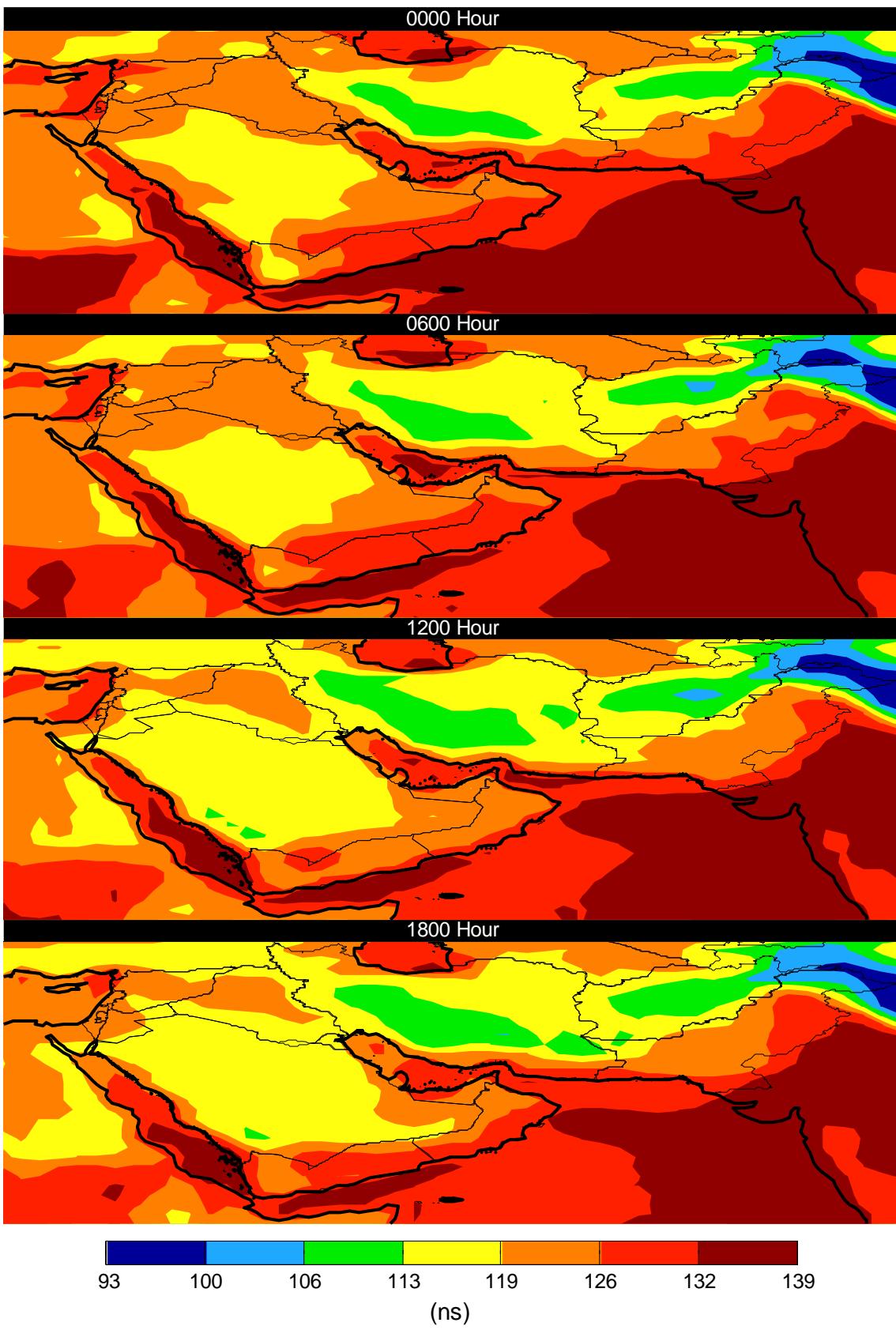
FNL Time Delay JUL 01 2003 5° Elevation
Middle East



FNL Time Delay JUL 15 2003 0° Elevation
Middle East



FNL Time Delay JUL 15 2003 3° Elevation
Middle East



FNL Time Delay JUL 15 2003 5° Elevation
Middle East

